

The structural and biological details of the human growth hormone

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Overview of Human Growth Hormone

The study aims to discuss the structural and biological details of the human growth hormone. The human growth hormones are a class of biosynthetic hormones that work inside the body, and people use them for various biological functions such as muscle strength, body toning, weight loss, and anti-aging. The physiological effects on the body, the benefits of the hormones, and their cons will also be discussed in the paper. Moreover, the use of GH in sort by athletes and the purpose of sports doping is also discussed for an explanation of growth hormone function inside the body from the perspective of abuse.

Molecular Structure of Growth Hormone

The growth hormone is a class of polypeptide chain made up of 191 amino acids. The hormone is responsible for the growth, regeneration of cells and reproduction as well. The weight of the growth hormone is 20,500 kDa.

Genetic and Evolutionary Background

The evolutionary perspective of the growth or somatotropin hormone dated 10 million years ago in a form of a cluster of genes, the study revealed that the human growth hormone is present on the same locus where there are four HCS A and B genes present for the synthesis of chorionic somatotropin hormone. The location of the human growth hormone is on the long arm of chromosome 17. The loci of chromosome 17 inhabiting somatotropin hormone are 122-24. [1]

Physiological Expression and Biological Role

The role of the human growth hormone is that it increases the amount of glucose and fatty acids and is also stimulates the synthesis of somatomedin IGF-I. The role of the hormone happens through an expression. The human growth hormone spliced up to Messenger RNA that leads to the formation of 20kDa variant. The human hormone is released through the anterior part of the pituitary gland. The variant then performs the oxidation in the adipose tissue of the body. This is a post-translational modification through which gene expresses and the growth hormone performs its function. [2]

Hormone Receptor Binding

The structure of the human growth hormone, as investigated by X-ray crystallography, revealed that a single growth hormone binds to the two conjugate receptors banded with membranes. The joining of the membrane-bound receptors happens in a way that site 1 of the receptor binds to helix 4 of the hormone, and site 2 binds to the 1 and 3 helices of the hormone. This binding of the hormone is necessary for the performance and activity of the hormone biologically. The binding follows the dimerization process which releases the formation of tyrosine kinase Jak-2 enzyme that adds the phosphate group to the receptor site through phosphorylation. [2]

Regulation of Growth Hormone Secretion

The secretion of growth hormones is managed through the regulation of different factors such as somatostatin, GHRH, ghrelin, and IGF-1. The regulation role by the factor GHRH lies in the proliferation of the somatotrophic hormone. [3] The level of the secretion of the growth hormone varies in pulses and frequency with age and biological system. The children will have low amplitude and frequency of the growth hormone, and with the arrival of puberty, the physiology becomes complex, and so will the amplitude and frequency of the hormone as well. There is a shift that happens with the gradual decline at the mid-age of humans, which happens due to the reduction in the insulin growth factor1. [2]

Direct and Indirect Physiological Effects

There are two ways in which growth hormones affect the body. One is a direct way, and the other is indirect. The direct effect happens when growth hormones affect the desired area, such as fat cells, and break down triglycerides present in fat cells. The targeting of fat cells also inhibits the fat cells to cut down the accumulation of fat cells. The second way is the indirect effect that involves the contribution of insulin growth factor {IGF-1}. The secretion of IGF-1 happens through the liver. The IGF-1 affects the desired area. [4]

Clinical Uses in Growth Disorders

The human growth hormone is used to control body fat and regulate metabolism. It also used to treat growth deficiency in children. Children who have syndromes such as Turner's syndrome and kidney disease mostly result in short-stature bodies. This is treated with growth hormone. In adults, the GH is responsible for cutting down the fat. Adults usually want to cut down fat and increase their muscles. The GH is used illegally sometimes in order to build strength and to boost endurance along with muscle strength. [5]

Athletic Use and Regulatory Restrictions

Although the International Olympic Committee has banned the use of GH for muscle building, it has been illegal for sportsmen to build endurance by exercising. A study conducted on the impact of GH tested for endurance and performance among 44 athletes in California. The persons under study were of 27 age, body mass index of 24 and all males. Three hundred thirty-seven athletes were given injections of growth hormone, and the rest of the 137 were given placebos. The result showed that persons with GH injections got 4.6 pounds gain in body mass but did not end up in improved strength for exercise sessions. [5]

Somatotropin mediates the production of protein content in young children. Utilizes fat through the insulin changes and control the insulin growth factor also, according to one study. The use of GH increases the effects of fluid retention in the body of the user, muscular and joint pain, and hand numbness. [6]

The HGH helps maintain the body shape and raise the height of short-sighted children to a normal level. They are short-height and can increase their height with the administration of human growth hormone therapy over three years. Most of the people use hormonal therapy to get a quality life and feel good about themselves. The use of hormonal injection should be administrated carefully as too much concentration can affect the body such as joint pain, swelling, headaches and muscular weakness.

Postoperative and Metabolic Applications

The postoperative condition of human body mediates the breakdown of protein inside the body due to excess release of calcium, phosphorus, and nitrogen. This condition leads to systemic injury after post-operation. The administration of human growth hormone proved helpful in the accumulation of protein after the surgery. According to a study, the use of biosynthetic human hormone proved beneficial to combat the breakdown of protein through the anabolism effect of human growth hormone. The post-operative condition comes with fewer nutrients uptake and nitrogen imbalance, it is managed by the BSHGH that results in increased blood glucose and increased fat oxidation in gastrointestinal operative patients. [7]

Treatment of Adult Growth Hormone Deficiency

The administration of growth hormone in adult patients with growth hormone deficiency is one way to treat the patients with beneficial effects on the deficiency. Bengtson et al. (1993) examined adults with hormonal deficiency. He used HGH replacement therapy for the desired effect on body composition and metabolism. 0.2-0.5 U/Kg was given to the patients with onset deficiency for three weeks. Body composition analysis is done through impedance, computational and potassium

concentration methods. The psychiatric effects were also determined in the study. The findings of the analysis suggested that HGH recombinant therapy is helpful in increasing muscular volume and reducing fat composition. The bone and mineral composition have also showed desired change. Moreover, the HGH also reduces the psychiatric symptoms as well as adults. [8]

Lipid and Protein Metabolism

The level of lipid molecules in adipose tissue of the body of the elders is regulated by Human growth hormone metabolism. The HGH first does the lipogenesis by breaking down lipid content through decreasing enzymatic activity. The effect of HGH checked in another came through the chorionic administration of the hormone. It induced the inhibition of glyceride production and reduced fat composition. Furthermore, the fatty acid oxidation that happens through the administration of HGH is accompanied by a decreased level of respiratory quotient and a rise in the ketogenesis process.

The human growth hormone also helps in protein metabolism. The HGH helps in the transference of amino acids from the extracellular region to the intracellular region of the cell by the C-alpha amino so butyric acid. The HGH, along with the increased level of C-AIB, also mediates the uptake of various amino acids, such as alanine. Threonine, serine, glycine, tryptophan, arginine, asparagine. It also helps the adherence of H=leucine amino acid into the protein itself. [2]

Therapeutic Benefits of HGH

The HGH, once it enters the bloodstream, remains inactive for a few minutes, and then the liver converts into usable growth factors responsible for the biological functions of the hormone. There are several benefits of human growth hormone. The first benefit is increased or improved muscular strength in adults. The humans take them to increase their strength capacity and HGH promotes it through the synthesis of collagen in tendons and muscles that leads to improved exercise potential swell. To test the effect, a study was conducted by the International Journal of Endocrine, which performed the HGH therapy on seven samples. The subjects were tested for hormone responsiveness, and results disclosed that HGH is helpful in maintaining good muscular strength in the abdominal portion of the body. Notable thermoregulation also occurred in response to the hormone. [9]

The second benefit is the regulation of bone and mineral metabolism, leading to the healing of fractures. The IGF1 factor is the key to the degeneration of bone structure, which mediates growth. According to the journal BONE, the investigation of the effect of HGH on the bone was done systematically through subcutaneous injections of the hormone. The result turned out positive for the healing of fracture with the applied injection therapy.

The third benefit of human growth hormone is in Weight loss regime. The key to weight loss by the hormone is the breakdown of lipid material in the fat tissues of the body. The hormone performs the breakdown of triglyceride content into glycerol content by the method of hydrolysis and free fatty

acids. These free fatty acid are suppressed for their lipid effect by the effect of HGH. Research was conducted on obese patients for the activity in a study published in the hormone research family. The patients were prescribed a strict calorie diet along with the administration of HGH. The results confirmed the weight loss in patients running a strict diet and using hormonal administration methods.

The HGH's fourth benefit is reduced heart disease risk. A study was conducted on 24 patients with a deficiency of HGH in Sweden. The HGH reduced the fat composition in patients, thus cutting down the risk of cardiovascular disease onset.

The HGH has also confirmed its effectiveness in the improvement of erectile dysfunction in men. Humans who have a deficiency of HGH are prone to impaired sexual desire and erectile dysfunction. The HGH is the hormone that helps in the maturation of the sexual cycle and improves desirability for sex.

To check the efficacy of the hormone, 35 healthy men and 45 erectile dysfunction men participated in the research. Both sets of men were exposed to visual stimuli to check penile erection. The result of the study showed that the patients with injections of the HGH had more erection around 90 percent increase than the persons with no HGH.

The last and long effect of the HGH is the initiation of quality life. People use it for the normal and quality psychological balanced life. The effect was examined through the analysis of cognitive functions in a Lithuanian study. The growth hormone of 12 IU per week was given to patients with a deficiency of hormones and examined for a six-month time period. The result displayed improved cognitive function and a good mood. [9]

Adverse Effects and Long-Term Risks

There is another side to the use of human growth hormones, which is obviously the downside. The use of HGH for long ties can impact the body negatively. The cons that come with it are high blood pressure problems, liver, heart, and spleen enlargement, carpal tunnel syndrome, sleep disturbances, swelling of tissues, and a high risk of polyps formation in the colon. One of the main dangers is that it reduces the lifespan of the individual by ten years. [10]

Adolescent Abuse and Anabolic Use

The HGH is reported as the abusive drug among the adolescents. The young people using this as anabolic steroids to get the desired body. The study was conducted for the purpose of HGH abuse in 224 males and 208 females. The purpose of the abuse was analyzed through a questionnaire, and the results showed that young adolescent was 30 percent knew that someone was using the HGH to get muscular strength and enhanced stamina. The abusers were aged 14-15. They were using it because

they just wanted to get the desired effects without being aware of the side effects that come along with the use of the HGH.[11]

Sports Doping and Illegal Use

The human growth hormone has been banned and labelled an illegal substance 1990. The growth hormone is helpful in sportspersons because of the anabolic function of the hormone and its metabolic properties of fat and carbohydrates,

The growth hormone injection into the bloodstream increases by ten times for the desired intensity of work. When a person intends to do a workout activity, the deposition of lactate in the muscles gets to 70 percent for 10-15 minutes. The HGH will increase it by 5-10 times leading to maximum intensity workout span for the sportsman. The other thing that human growth hormone do is the release of it into the bloodstream which leads to the increasing amplitude of the pulses of the individuals.

The preference of the drug by the sportsman is due to its effectiveness's on getting desired endurance and muscular strength. The sportsmen take around 10-25IU/day for 3-4 times a week. The sportsperson uses it with other doping chemicals called steroids or EPO. They do it because they want lean body composition. [12]

Sports doping has been the most controversial issue worldwide. Many athletes from baseball, football, and cycling confirmed the use of illegal growth hormones. One study recognized the Huma growth hormone for its effectiveness on the muscles and labelled as "wonder substance" because it stimulates the anabolism in muscles and ripped the muscles resulting in improved stamina in sportsperson. The study conducted on the hormones effect on exercise, strength and metabolism in 440 individuals.

Evidence on Strength and Athletic Performance

The physiological effect of the human growth hormone on strength showed that it did not improve bicep or quadriceps strength in individuals. The analysis of basal metabolism showed increased heart metabolism to rest. It was 3.8 beats /min in persons with HGH injections. Similarly, the exercise ability was high in patients with HGH because of the increased fatty acid oxidation activity and increased metabolism. The free fatty acid and glycerol content was also high in patients and thus, triggered the respiratory quotient.[13]

HGH increased athletic performance. According to the published article ESPN, research was done by giving injections of hormones to 103 male athletes and 40 females' recreational athletes for a time period of 2 months. The scientific evidence that came out of the result accepted that Human growth hormone increased the sprinting capacity by 4 percent with HGH in females and 8 percent in male athletes. The researchers also observed that there has been a boost in galloping and with HGH, one

can reduce half of a second in the 10-second sprint.

Sportspersons use the hormone to improve sprint activities like swimming and running. This kind of activity requires a lot of energy, and reducing the sprint second can make anyone a winner on the go.[14]

Conclusion on Benefits and Risks

The paper conversed detail about the human growth hormone structure, physiological route, regulation and the effects on the body. Human growth hormones have therapeutic benefits, such as a reduction in heart disease risk, recovery from post-operative injury, bone regeneration, and weight loss. But things go wrong when someone abuses the hormone and takes it to improve muscular strength, reverse the aging process, and for various other purposes to get the biological system run before natural time. It has been labeled as illicit by all countries, but still, it is being used as an off-label drug by sportsmen and fitness freaks. There should be proper awareness regarding the medication or chemical that you put into the body system. Growth hormones might work effectively and give you good results in a quick time, but the side effects cannot be reversed, and they pose harm to your life. One should find another natural way to boost metabolism and improve performance rather than using hormones.

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