Problems with GH doping in sports

M. Bidlingmaier, Z. Wu and C.J. Strasburger
Neuroendocrine Unit, Medizinische Klinik - Innenstadt, Klinikum der Ludwig-Maximilians - University, Munich, Germany

ABSTRACT. Human hGH is listed as a prohibited class E substance by the International Olympic Committee (IOC), and its use is considered as doping. However, until today the likelihood of being punished for using recombinant hGH is very limited: once injected, it is believed to be undetectable by laboratories. No official test is implemented in the doping control procedures, and the only situation when athletes were found guilty of doping with hGH arose from actions of customs officers or policemen arresting athletes carrying ampoules with them. The primary reason for the lack of an accepted test method is the amino acid sequence identity between the main fraction of pituitary derived hGH and recombinant hGH, which makes it difficult to discriminate between endogenous and exogenous hGH. In addition, hGH is known to have a very short half-life time in circulation of around 15 min. Recent efforts of endocrine researchers led to the identification of two main strategies promising to be useful for the detection of recombinant hGH application, which are reviewed in this article: on the one hand, changes in GH-dependent parameters after administration of recombinant GH have been shown to be possible indicators of GH abuse, because the increase in various parameters following recombinant hGH administration exceeds the variability commonly observed in normal, healthy subjects. More directly, another approach focuses on changes in the hGH isoform pattern in serum occurring after injection of recombinant hGH. Because of the negative feedback on pituitary hGH secretion, the relative abundance of isoforms other than 22 kD are greatly reduced after administration of recombinant hGH, which only consists of the 22 kD hGH isoform.

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POTENTIAL BENEFITS AND RISKS OF DOPING WITH GROWTH HORMONE

In 1992, an anonymous survey revealed that about 5% of male American high-school students had used human GH (hGH) as an anabolic agent at least once in their life (1). However, within the scientific literature, the potentially beneficial effects of recombinant hGH application in normal healthy adults are far from being generally accepted. The use of prohibited substances is driven by the expectation of an increased performance, but the exact nature of an “increased performance” depends on the sports discipline. In a recent report, Wallace et al. (2) listed a variety of possible beneficial effects for various disciplines. Because the promotion of longitudinal growth is the main effect of treatment with recombinant hGH in children, one might speculate that recombinant hGH might be misused to increase final height in children or adolescents foreseen for a career in basketball, high jumping or other disciplines where an increased height provides an advantage. Although no data are available about the frequency of doping in children and adolescents, this issue is obviously important because of the possible long-term consequences on general health.

Changes in body composition could be of interest for athletes in sports disciplines organized on body weight categories, like boxing or wrestling. The desired increase in muscle mass accompanied by a decrease in fat mass could lead to the advantage of bearing more muscle at the same weight as a competitor. It is well known that in GH-deficient (GHD) adults, recombinant hGH replacement therapy leads to profound changes in body composition (3-6). This effect seems to be more pronounced in
From childhood-onset GHD patients we know that cardiac and pulmonary function might be of interest. Especially in endurance sports, the effects of hGH on treatment in GHD patients to normal, trained athletes valiation of the beneficial effects of recombinant hGH in trained athletes (23). Apparently, a simple extrapolation of the beneficial effects of recombinant hGH administration is dependent on the body composition of the individual and attenuated in healthy trained adults in comparison to GHD patients.

The known protein anabolic properties of hGH might be the most important reason for its popularity in sports, especially in strength athletes like sprinters, weight lifters and bodybuilders. Reduced skeletal muscle mass and muscle strength (12-14) in GHD adult patients are reversible by replacement therapy with recombinant hGH (3, 5, 6, 15-17). On the other hand, a chronic excess of hGH like in acromegalic patients improves the cardiac function as well (31). A combination of several hGH effects theoretically could contribute to an improved exercise performance. In addition to its direct effects on cardiac and pulmonary muscles, hGH is known to have profound effects on fuel metabolism (32), erythropoiesis and total blood volume (33); but until today no studies have been published on beneficial effects on heart or lung capacity in healthy trained subjects.

From the scientific literature, it is hard to understand why doping with hGH gained such attention, because the results from controlled studies make a dramatic effect of recombinant hGH in highly trained adults very unlikely. Of course, in addition to the effects mentioned above, other actions of GH including its involvement in wound healing, collagen and bone turnover are known and might argue for a performance enhancing potential. An explanation of the apparent discrepancy between the hGH abusers’ subjective reports and the objective data from studies could be the duration and dosage of hGH treatment (34). Underground reports from hGH abusers mention doses up to 25 IU/day, which is much higher than the dose of 1-2 IU/day given in adult GHD patients. Furthermore, cheating athletes frequently use more than one performance enhancing drug, making it difficult to discriminate between each substance effects and the effects of their combination. Obviously, a scientific re-evaluation of the effects of such “treatment regimes” in controlled studies prohibits itself for ethical reasons.

In contrast to the controversial issue of a potential enhancement of performance evoked by recombinant hGH treatment in healthy adults, the issue of side effects and health hazards becomes much more evident with the increasing knowledge on hGH. Several Authors emphasized the