Gene Doping: Creating the Super-athlete

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'Gene Doping' is a new approach to an ancient desire: How to give an athlete a competitive edge. The Greeks used hallucinogenic mushrooms and the Romans used speed. More recently, anabolic steroids were the drug of choice. But today, an athlete already has the edge he/she needs, its just waiting in the genes. Since the mapping of the human genome, scientists now know what genes are responsible for a host of physical properties, including strength and stamina. If an athlete needs to be stronger, just increase the release of HGH (human growth hormone). Need to run further, faster? Tell your body to create EPO (erythropoietin), a hormone responsible for creating more red blood cells. The technique is surprisingly simple: Inject the DNA responsible for releasing these hormones into the athlete several days or several weeks before competition.

Figure 1: Mary Albury-Noyes

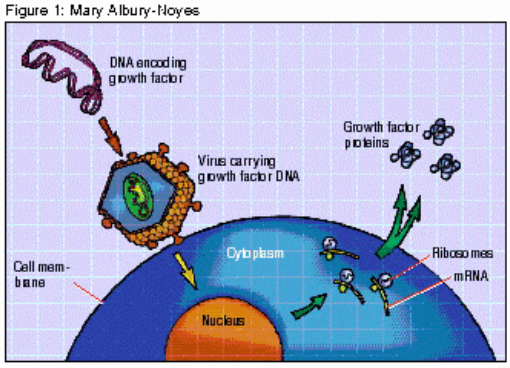

FIGURE 1. Gene therapy can be used to stimulate healing of injured musculoskeletal tissue. Gene transfer can be accomplished by using a viral vector. Genes to be inserted (here a growth factor gene) are incorporated into a truncated viral genome and packaged into a virus particle. Virus particles infect the target cells. where the growth factor gene is transported to the nucleus and is either integrated into hosto chromosomes or maintained as an episome. With the help of viral and cellular proteins. the gene is transcribed into messenger RNA (mRNA). The mRNA is then translated into growth factor protein by the cellular machinery and the ribosomes. Growth factor protein is then secreted and exerts its effect on surrounding tissues.

The mechanism for delivery, however, is quite a different situation. There are two general types of delivery, transduction and transfection. Transduction involves using a viral vector to deliver the DNA to the host cell whereas transfection is a non-viral delivery system utilizing liposome, DNA, or DNA-protein complex. (The medium is also referred to as a plasmid.) While the non-viral administration has a lower toxicity and immunogenicity, it is not as efficient at delivering the genetic material, as is the viral approach. However, viral vectors have disadvantages of their own, such as a low capacity for gene insert as well as immune system rejection. The true bioengineering task lies in the development of an effective and safe delivery system capable of adapting to the changing demand of different DNA structures.

The most biologically challenging aspect to this type of gene therapy is controlling the growth. All physiological regulatory systems have an on/off mechanism that prevents over-stimulation. It is unclear what long term reaction the body will have if its hormone production is kept in the 'on' position. Cancer and cystic fibrosis seem to be the most likely, if any, possible side affects.

Until now, the evolution of man has been measured in millennia. In the 21st century, the evolution of man will be measured in days.