Drug Bytes

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Side Effects of Anabolic Steroids in Kids

Three to 5 percent of school-aged kids have used anabolic steroids. Steroid use in kids is a significant public health issue, even though it pales in comparison to teen use of alcohol, tobacco and marijuana. Steroids can cause serious side effects in growing kids and laws against steroid use in adults are aimed largely at preventing steroid use in kids and preserving the “purity of sport.” Steroid side effects are greater in children and women than in adult men. They can cause the bone growth centers to close prematurely, make normal skin problems of youth even worse and trigger psychological disturbances in already-volatile teens. Long-term use of steroids in adolescents can cause irreversible changes to the reproductive system that can severely impair fertility in boys and girls. Women who take steroids may suffer from balding, abnormal hair growth, cliteral hypertrophy, voice changes, reduced breast tissue, masculinization, increased sex drive and abnormal menstrual cycles. Steroid use among high school girls is nearly the same as in boys, which is a disturbing trend. (Pediatric Clinics North America, 54: 677–690, 2007)

Gene Doping in Sports

Gene technology will help identify athletic potential, fabricate new performance-enhancing drugs and alter gene function to speed muscle growth, strength, endurance and reduce fat. Many genetic methods will be valuable to bodybuilders and other athletes. These techniques include: 1) Recombinant DNA technology: This involves fabricating hormones and chemicals in test tubes using genetically altered organisms. Good examples include growth hormone, insulin and erythropoietin (EPO, a blood booster). 2) Drugs that influence genes: Some drugs or hormones can influence genes to produce enzymes or other proteins that improve performance. For example, anabolic steroids stimulate genes to produce more muscle protein so that muscles grow (hypertrophy). 3) Gene therapy: This involves transferring entire cells that have not been genetically modified into tissue via harmless viruses in the hope of improving the tissue’s function. Gene therapy can either promote or block physiological processes. 4) Germ-line gene transfer: This involves transferring genes to eggs or sperm in the hope of altering the genetic content of future generations. For example, a gene variant that promotes muscle hypertrophy and sprint speed might be transferred to an egg in the hope of developing a future Mr. Olympia or Olympic sprinter. 5) Gene identification: Scientists may one day identify children who have genes that give them a natural advantage for developing more muscle mass, strength, power, endurance and less body fat. Genetic manipulation is a reality and will alter sports, as we know it. (Pediatric Clinics North America, 54: 807–822, 2007)

Brief History of Anabolic Steroids

Testosterone research began in ancient times. Farmers learned that castrated animals had reduced sex drive and were more docile. Royalty in Persia employed castrated men called eunuchs to guard the harem because they had reduced sex drives. Modern scientific research began in 1889, when 72-year-old French scientist Charles Brown-Édouard reported that testicular extracts of dogs and guinea pigs made him feel younger and more virile. His report triggered widespread use of testicular extracts in Europe and North America for more than 30 years. We have no report that athletes used the preparations, but they were widely heralded as a health tonic, so it is possible that some athletes used them to improve performance. Ernest Laqueur isolated testosterone from bull testes in 1934 and received the Nobel Prize for his discovery in 1935. This started a lively debate in the medical community regarding testosterone replacement therapy that continues to this day. The early interest in testosterone centered on its effect on libido and sexual performance. Eventually, widespread drug use to improve performance was almost a given. Excesses in drug use in sport began to catch up with the athletes. In 1968, the International Olympic Committee (IOC) began the first large-scale drug-testing program at the Grenoble winter Olympics and the Mexico City summer Olympics. The early history of athletic drug testing was controversial and inconsistent. Depending on the steroid, athletes could go off the drug for two to four weeks and appear perfectly clean during drug testing. Beginning in the late 1980s, the IOC instituted random drug testing of elite athletes. These athletes were expected to inform officials of their location and be prepared to submit a urine sample within 48 hours at any time. If they refused, they would be treated as though they tested positive for banned drugs and would receive sanctions. Professional baseball and the National Football League introduced drug-testing programs in 2004 to stem the tide of drug use in sports. Drug testing involves collecting urine samples from athletes chosen at random several times per year. The tests will not catch athletes who use growth hormone or rapidly clearing testosterone creams or gels. The program gives baseball and football the illusion of a testing program without disrupting performances

that make the sports popular and upsetting the revenue stream. The recent Mitchell report on steroid use in Major League Baseball will probably lead to more stringent drug-testing policies in all sports. (Pediatric Clinics North America, 54: 761–769, 2007)

Operation Raw Deal Targets Steroid Manufacturers

The BALCO scandal, the arrest of Sylvester Stallone in Australia for illegal growth hormone possession, and the recent Mitchell report on steroid use in Major League Baseball have motivated the feds to get tough on steroid manufacturers and dealers. They have specifically targeted people purchasing and reselling raw materials from China as well as those importing growth hormone and insulin-like growth factor for sale in the United States. The U.S. operation was coordinated with law enforcement agencies in Mexico, Canada, China, Belgium, Australia, Germany, Denmark, Sweden and Thailand. The feds closed down 56 steroid labs in America and more than 100 Internet sites. Operation Raw Deal resulted in nearly 150 arrests since September 2007. (Justice Department Documents And Publications, September 24, 2007)

Myostatin Blockers and SARMs

Breakthroughs in medicine, electronics and the increased availability of information have been breathtaking during the past 50 years. Sports drugs and supplements are no exception. Artificially produced growth hormone, IGF-1 and insulin have presented serious challenges to organized sports. New discoveries in genetics have led to the development of the next generation of sports drugs: myostatin blockers and SARMs. Myostatin is a protein that prevents skeletal muscle growth. Blocking the myostatin gene with drugs can cause large increases in muscle mass. Selective androgen receptor modulators (SARMs) target androgen receptors in specific tissues, such as muscle or bone. SARMs are the Holy Grail of anabolic chemicals because they will build muscles without affecting other organs or tissues. Muscle-focused SARMs will be of great interest to older adults experiencing bone or muscle loss, patients suffering from trauma or degenerative diseases, or athletes trying to improve performance. These drugs exist, so it’s only a matter of time before athletes use them. (ABC News, October 26, 2007)

Growth Hormone Boosts Mitochondrial Function

As you learned in high school biology, the mitochondria are the powerhouses of the cells. They produce large amounts of adenosine triphosphate (ATP) that provides energy for muscle contraction, protein synthesis, body water control and nerve impulses. A study from the Mayo Clinic showed that growth hormone (GH) increases the metabolism of the mitochondria. They infused GH into healthy adult men and women (age 30) and produced 400 percent increases in blood levels of IGF-1 (muscle growth factor), insulin, glucose and free fatty acids. GH increased fat use by 29 percent, ATP production by about 25 percent and protein synthesis throughout the body. The study showed that GH increased the aerobic capacity of cells, increased protein synthesis and boosted fat use. It also demonstrated why GH is so popular with athletes and older adults. (Journal Clinical Endocrinology Metabolism, in press; published online November 13, 2007)

Salbutamol Builds Muscle

Salbutamol (called albuterol in the United States and sold as Ventolin)— is a beta 2-adrenergic agonist drug (assists adrenaline) used to treat airway spasms in people with asthma. The International Olympic Committee (IOC) banned it, except for athletes given medical exemption. Salbutamol is similar to clenbuterol, which is popular with some bodybuilders because it builds muscle. British researchers determined that salbutamol was also anabolic and worked by binding to androgen receptors in muscles. Their experiment measured binding rates to androgen receptors in cell cultures. This study showed that beta 2-adrenergic agonist drugs work much like testosterone to promote protein synthesis. Another British study showed that salbutamol increased quadriceps and hamstring muscle strength but did not affect lean body mass in healthy men. (British Journal Sports Medicine, 41: 874-878, 2007)

GHB Increases Growth Hormone and Promotes Wound Healing

Gamma-hydroxybutyrate (GHB), the so-called date rape drug, was popular with bodybuilders about 15 years ago. They

recognized that it was highly anabolic. It is approved for treating narcolepsy (extreme daytime sleepiness) but it is often prescribed for people suffering from chronic fatigue. Illicit use caused the Food and Drug Administration (FDA) to classify GHB as a Schedule I drug. This put it in the same category as heroine and means that it is extremely dangerous. GHB use has serious risks, including coma and death, but might have significant therapeutic effects. Irish researchers found that GHB increased growth hormone levels and promoted wound healing in rats. GHB improved the health of the cells lining the blood vessels by increasing growth hormone levels. It is marketed in the United States by Jazz Pharmaceuticals and has a variety of medical uses— most of which are not presently approved by the FDA. (Journal Trauma, 63: 1099-1107, 2007)