Throughout history, athletes have used all types of ergogenic aids to attempt to improve performance. Today's athlete has available a myriad of possible substances and techniques purported to maximize performance. One popular way to attempt to gain an advantage is by increasing one's muscle mass, a key component in many competitive sports. This concept led to the development and use of anabolic-androgenic agents. Androstenedione has recently become a popular choice as a possible anabolic performance enhancer.

Active individuals can get information about androstenedione from a variety of sources. To encourage well-informed choices, athletic trainers and therapists should prepare to communicate accurate information about this substance. As such, the purpose of this article is to enlighten sports health care providers about androstenedione, so that they in turn will be prepared to inform potential consumers. Androstenedione and related terms are defined, basic physiology is described, and its history is detailed, as are its classification and possible side effects.

Definitions

Anabolic refers to the building up of muscle or tissue, whereas androgenic relates to enhancing one's malelike or masculine traits. According to Stedman's (Dirckx, 1997), androstenedione is an androgenic steroid of weaker biological potency than that of testosterone, but Yesalis, Kennedy, Kopstein, & Bahrke (1993) and Sahelian (1999) consider androstenedione highly androgenic. Blue and Lombardo (1999) assert that androstenedione is a “potent anabolic steroid” (p. 683).

Physiology

Androstenedione is endogenously created in humans, with the primary production sites being the adrenal glands, the testes, and the ovaries. Through a complex reaction (see Figure 1), androstenedione is converted from either dehydroepiandrosterone (DHEA) or 17-alpha OH progesterone. In turn, androstenedione can be metabolized into either the male hormone, testosterone, or the female hormone, estrone (Wadler & Hainline, 1989). One should note that some of these reactions are reversible (androstenedione to testosterone to androstenedione).

History and Science of Androstenedione

Acetate → Cholesterol → Pregnenolone → 17αOH Pregnenolone → Progesterone → 17αOH Progesterone → Dehydroepiandrosterone (DHEA) → Estradiol → Estrone → Estriol

ANDROSTENEDIONE

Dihydrotestosterone → Testosterone → Androsterone

Etiocholanolone → Corticosteroids

Corticosteroids

1935). In another key early study, castrated canines treated with androstenedione incurred both androgenic and anabolic effects (Kochakian & Murlin, 1936). Only two scientific research studies have been published in the peer-reviewed literature concerning the human use of androstenedione as an ergogenic aid. Mahesh and Greenblatt (1962) reported a significant elevation in blood testosterone levels of two women after androstenedione supplementation (100 mg). Although theirs was an important study, its limitations are apparent: including only women (with low natural baseline testosterone levels) as participants. No measurements were made in relation to body composition, muscle strength, muscle-fiber size, or physiological performance. The authors simply reported an immediate, but short-lived, increase in testosterone levels.

These findings led to androstenedione experimentation in Eastern-bloc countries through the 1970s and '80s. Although unpublished, Hacker and Martern in their 1995 German patent reported that oral ingestion of androstenedione (50 or 100 mg) increased serum testosterone from 140% to 237% within 15 min. Participants were not described as to gender, age, or health status. Data for support of these claims were not presented in the patent application. In addition, during these years East German athletes were treated with intranasal pulses of androstenedione, in order to attempt to raise testosterone levels and thus increase athletic performance (Gwartney & Stout, 1999).

Since then, androstenedione remained an obscure anabolic supplement until Mark McGwire's record-breaking year in 1998. Androstenedione has since become one of the most sought-after supplements available. Athletes and nonathletes alike, in hopes of "legally" reaching their ultimate genetic potential, presently spend many millions of dollars on androstenedione.

In only the second peer-reviewed article on androstenedione, King et al. (1999) published the results of their study looking at androstenedione as a supplement. Their design involved a randomized and controlled 8-week trial on 30 healthy male participants. During this time, participants resistance trained while blindly receiving either androstenedione or a placebo. Results suggested no significant increase in