



Clinical Pharmacology & Toxicology Pearl of the Week

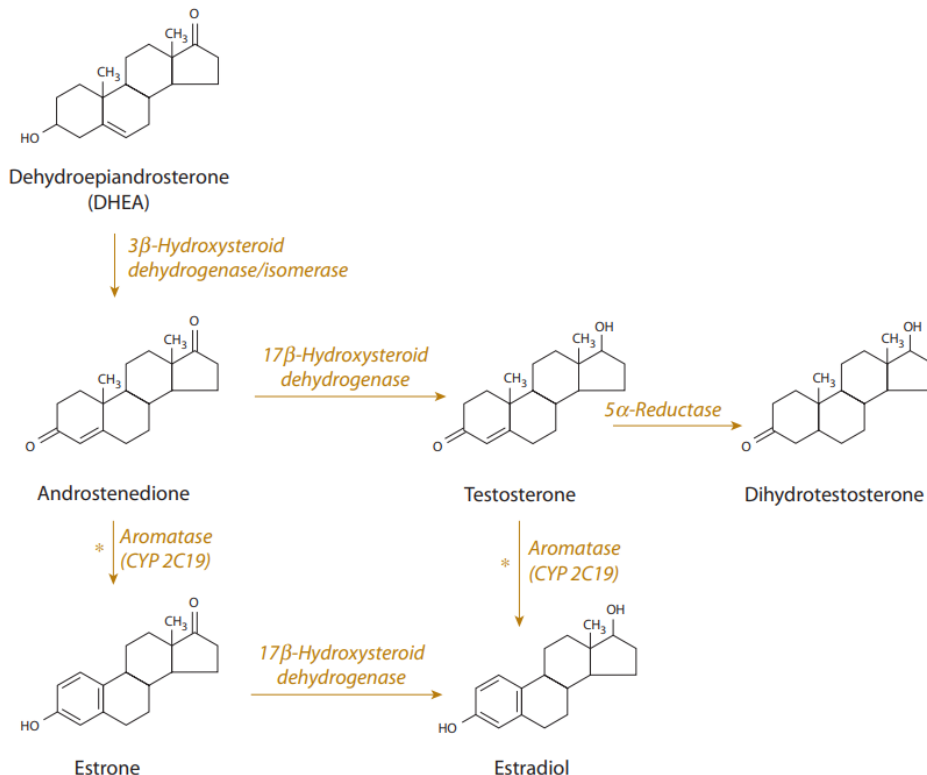
~ Anabolic Steroids in Athletes ~

Background

- ✓ "Sports doping" refers to the use of a prohibited drug to enhance athletic performance
- ✓ Athletic performance enhancers are classified in several ways depending on their anticipated effects, for example increasing muscle mass, increasing energy, decreasing recovery time, or masking the presence of other drugs
- ✓ Use of these drugs is common not only in athletes, but also in adolescents not involved in organized athletics for aesthetic purposes
- ✓ Illicit use is associated with adverse effects affecting several organ systems

Anabolic Androgenic Steroids (AASs)

- ✓ AASs are a group of synthetic molecules derived from testosterone and its precursors, used to increase muscle mass and lean body weight
- ✓ These include alkylated derivatives that are lipophilic and administered orally, ester derivatives that are hydrophilic and administered parenterally, as well as topical preparations that are administered as a buccal gel, dermal gel or transdermal patch



Adverse Effects

- ✓ *Cancer*
 - Testicular and prostate cancer are reported in more frequent users of AASs

- ✓ *Cardiovascular*
 - Use of AASs is associated with myocardial fibrosis and biventricular hypertrophy with reduced left ventricular systolic and diastolic function
 - There is a dose-dependent association with coronary atherosclerosis, in addition to increased platelet aggregation and a decrease in HDL cholesterol
 - Thromboembolic complications include pulmonary embolus, stroke and cerebral sinus thrombosis
- ✓ *Endocrine*
 - Conversion of AASs to estradiol in peripheral tissues results in feminization in male athletes, including gynecomastia which can be irreversible
 - The negative feedback inhibition of GnRH, LH and FSH from the hypothalamus can result in testicular atrophy and decreased spermatogenesis in males, and menstrual irregularities in females
- ✓ *Hepatic*
 - Hepatic hemorrhage can result from subcapsular hematomas or peliosis hepatis, a condition of blood-filled sinuses in the liver which can also rupture
 - Alkylated androgens can result in hepatotoxicity
- ✓ *Dermatologic*
 - A common triad of acne, striae and gynecomastia commonly occurs
- ✓ *Neuropsychiatric*
 - Aggressiveness, irritability, hostility, anxiety, and mood lability may occur
- ✓ *Musculoskeletal*
 - Steroid use can result in tendon and ligament ruptures
- ✓ *Infectious*
 - Local complications from injection include septic joints, cutaneous abscesses and transmission of infectious diseases (HIV, hepatitis B, hepatitis C)

Sudden Cardiac Deaths in Athletes

- ✓ Unfortunately, many unexpected cardiac deaths occur in young athletes that are linked to the use of AASs and other athletic performance enhancers
- ✓ The leading cause of non-traumatic death is related to cardiac anomalies, with hypertrophic cardiomyopathy being the most common structural abnormality
- ✓ Other mechanisms include increased atherogenesis and vasospasm resulting in myocardial infarctions, thrombosis, and arrhythmias induced by myocardial fibrosis

References

1. Nelson L, Lewin N, Howland M, Hoffman R, Goldfrank L, Flomenbaum N. Goldfrank's Toxicologic Emergencies. 11th ed. New York: McGraw Hill Medical; 2019
2. Torrisi M, Pennisi G, Russo I et al. Sudden Cardiac Death in Anabolic-Androgenic Steroid Users: A Literature Review. *Medicina*. 2020(4);56-586.



The Calgary Clinical Pharmacology physician consultation service is available Mon-Fri, 9am-5pm. The on-call physician is listed in ROCA. Clinical Pharmacology consultations are also available through Netcare e-referral process and through Calgary Zone Specialist Link. Click [HERE](#) for more details.



The Poison and Drug Information Service (PADIS) is available 24/7 for questions related to poisonings. Please call 1-800-332-1414 (AB and NWT) or 1-866-1212 (SK).