



## Clinical Pharmacology & Toxicology Pearl of the Week

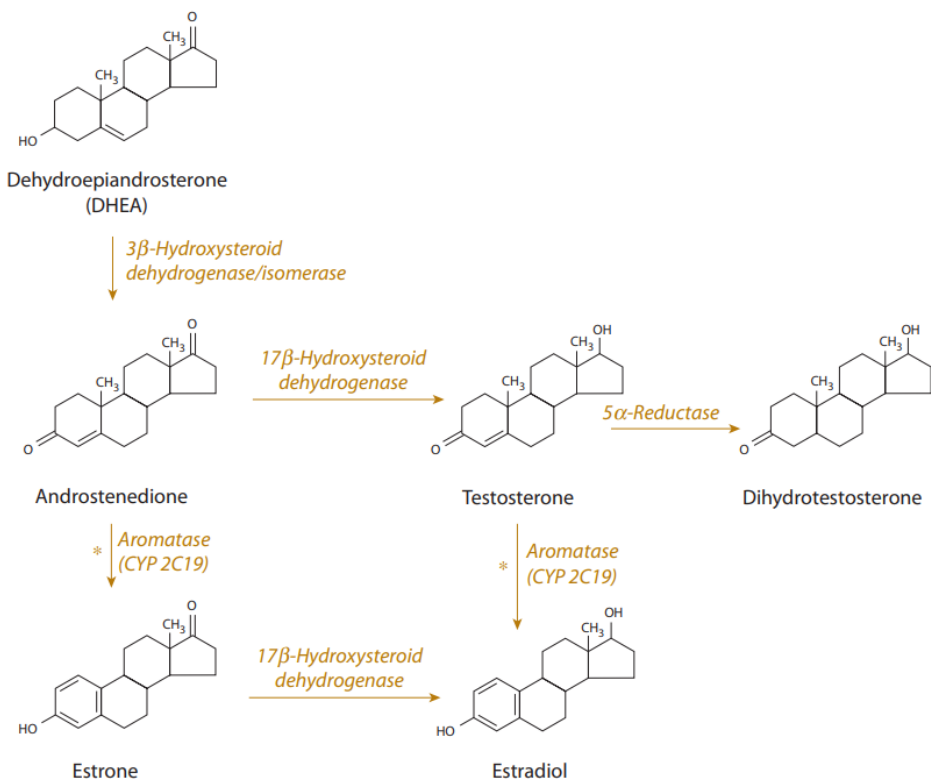
### ~ Anabolic Steroids in Athletes ~

#### 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. 11<sup>th</sup> 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 Clinical Pharmacology (CP) physician consultation service is available Mon-Fri, 8am-5pm. The on-call physician is listed in ROCA on the AHS Insite page. CP consultations are also available through Netcare e-referral and Specialist Link. You can also find us in the [Alberta Referral Directory](#) (ARD) by searching “Pharmacology” from the ARD home page. Click [HERE](#) for more details about the service.

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 1-866-454-1212 (SK). Information about our outpatient Medical Toxicology Clinic can be found in [Alberta Referral Directory](#) (ARD) by searching “Toxicology” from the ARD home page.

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