

Anabolic Steroids

Background

1. Definition
 - Anabolic androgenic steroids (AAS) are a type of performance enhancing drug (PED)
2. General info
 - PED
 - Any substance taken in non-pharmacologic doses specifically for improving sports performance¹
 - Use at all levels of competitive athletics is banned²
 - AAS include
 - Methyltestosterone, nandrolone, stanozolol, testosterone, androstenedione, DHT, DHEA, clenbuterol, selective estrogen receptor modulators
 - PEDs have been used since Greeks competed in ancient Olympics³
 - Testosterone
 - First synthesized in the 1930's
 - Introduced to sporting arena in 1940's and 1950's²
 - International Olympic Committee (IOC)
 - Founded in 1960's administers anti-doping tests to create equal and fair competition among athletes³
 - "Prohibited List" of substances is available from World Anti-Doping Agency
 - <http://www.wada-ama.org/>
 - AAS-schedule III controlled substances
 - AAS non-prescription use is illegal
 - Punishable as a felony

Pathophysiology

1. Pathology of AAS use
 - Believed to exert effects by
 - Binding androgen receptors
 - Stimulating production of RNA
 - Increasing protein synthesis
 - Anti-catabolic effects
 - Improve utilization of protein
 - Inhibit catabolic effect of glucocorticoids
 - May lead to gains in strength by
 - Increasing aggressiveness
 - Inducing euphoria
 - Decreased sense of fatigue during training allowing a higher intensity and longer duration of training
 - Precise effects on athletes are unknown
 - Clinical effects determined by
 - Type and concentrations of androgen receptors in target organ
 - Enzymes controlling steroid metabolism in a given organ

- Extrapolated from side effects of therapeutic drug dosages
 - Potential direct/indirect effects enhancing sport performance
 - Generic anabolic effect
 - Muscle hypertrophy
 - Weight gain with subsequent increased strength, power, speed, endurance, aggressiveness³
 - Most profound effects noted with⁴
 - High doses used by individuals who trained heavily prior to use
 - Continued training during use
 - Maintaining diet adequate in calories and protein
 - Demonstrated increase in maximal single lift strength
 - Strength gains lost after cessation of drug
 - Aerobic and endurance activities are not enhanced
 - Various side effects³
 - Hypertension
 - Myocardial damage
 - Hepatoma formation
 - Psychosis
 - Prostate hypertrophy
 - Female virilization
 - Uterine atrophy
 - Addiction
2. Incidence, prevalence
 - No data available on prevalence of AAS use in adult athletes
 - 46% of all athletes use a variation of performance enhancing supplements⁵
 - National collegiate sport level anabolic agent use is 8%²
 - 4-11% of male and up to 3.3% of female high school students use AAS⁶
3. Risk factors
 - AAS use most common in
 - Males
 - Non-Caucasians
 - More common in middle school than high-school²
 - Both male and female adolescents who participate in weight-related sports
 - Female AAS users are less likely to play school-sponsored team sports⁷
 - Female adolescent athletes reporting AAS use are more likely to be clinically depressed (OR 4.13), and have a marked increase in additional health-harming behaviors⁷ including increased past 30-day use of
 - Alcohol (OR 8.83)
 - Cigarettes (OR 5.14)
 - Cocaine (OR 10.78)
 - Diet pills (OR 4.86)
 - Marijuana (OR 7.91)
 - More likely to carry a weapon (OR 7.54)
 - More likely to have had sex before age 13 (OR 2.90)

4. Morbidity / mortality

- Presumptive morbidity linked to side effects of AAS use
- Mortality rate unknown

Diagnostics

1. History

- AAS user must be identified with a reliable history to identify those at risk¹
- AAS users
 - Athletes involved in weight-related sports demanding high degrees of strength, power, size, speed
- Sports such as gymnastics, wrestling, football, baseball, weight-training, and bodybuilding have highest prevalence of AAS use¹
- Adolescents not involved in sports but being intimidated or bullied may use AAS to appear stronger or to defend themselves¹
- Male AAS users report higher rates of depressed mood, poorer self-esteem, and attempted suicide²

2. Physical exam

- Most adolescent AAS users do not have any distinguishing physical findings¹
- Height, weight, BMI, body composition, degree of muscularity should be examined/compared to previous measurements
- In individuals who discontinue AAS use, size and strength often diminish dramatically
- Elevated blood pressure
- Males (often irreversible)
 - Acne
 - Male-pattern baldness
 - Gynecomastia (irreversible)
 - Testicular atrophy
 - Severe striae
- Females
 - Acne
 - Male-pattern baldness
 - Hirsutism
 - Clitoral hypertrophy (irreversible)
 - Deepening of voice
- Needle marks on the skin/skin abscesses may be evident¹
- Long term AAS users often exhibit many characteristics of classic addiction
 - Cravings, difficulty in ceasing steroid use, denial, withdrawal symptoms²
- Withdrawal symptoms similar to those seen with alcohol and opioid withdrawal such as
 - Diaphoresis, myalgias, nausea, elevations in blood pressure, tachycardia, major depression⁶

3. Diagnostic testing
 - Laboratory evaluation
 - Several agencies regulate the use of banned substances including
 - World Anti-doping Agency (WADA)
 - US Anti-Doping Agency (USADA)
 - NCAA
 - High school drug testing programs
 - Drug testing for exogenous substances using gas chromatography with mass spectrometry may be used-limited value/availability¹
 - Urine testing is available for AAS detection
 - Liver function tests can be elevated 2-3 times normal range
 - Usually return to baseline within several weeks of discontinuation⁶
 - Lipid profile may show decreased HDL/increased LDL
 - Additional testing
 - Hepatitis B, hepatitis C, HIV, basic metabolic panel¹
 - Diagnostic imaging
 - No imaging indicated
 - Hepatocellular adenomas have been associated with high-dose/ long term AAS use
 - Ultrasound may be used to detect liver masses in AAS users with abnormal LFTs or suspicious signs/symptoms⁶

Differential Diagnosis

1. Acromegaly
2. Congenital adrenal hyperplasia
3. Secondary amenorrhea
4. Body dysmorphic disorder
5. Klinefelter's syndrome
6. Adrenal tumor
7. Polycystic ovarian syndrome

Therapeutics

1. Counseling and education programs to help AAS users to stop
2. Prevention programs directed at high risk groups

Follow-Up

1. Return to office
 - Screen for risk factors during routine visits
 - Counsel to promote prevention
 - If risk factors present, consider regular follow-up for counseling and education
 - Established or former AAS users should have laboratory monitoring and imaging according to associated signs and symptoms
2. Refer to specialist
 - Endocrinologist depending on laboratory findings and persistent signs and symptoms²
 - Severe or recurrent male gynecomastia

- Raging acne resistant to usual therapies
 - Athletic adolescent females with 2° amenorrhea
 - Unusual tendon injuries
 - New onset type-2 diabetes in an athlete
 - Sexual aggression
 - Aberrant rage behaviors
 - Psychiatrist in the event of withdrawal symptoms or evidence of major depression
 - Consider GI referral if persistent liver function abnormalities
3. Admit to hospital
- Life-threatening withdrawal symptoms, psychotic events, evidence of major depression, suicide risks, or risks of harm to others

Prevention

1. The Adolescents Training and Learning to Avoid Steroids (ATLAS) program is a formalized AAS abuse prevention program for male athletes
 - In a cohort study, ATLAS resulted in significantly lower intentions to use ($P < 0.05$) and actual use ($P < 0.04$) of AAS in adolescent male athletes⁹
2. The Athletes Targeting Healthy Exercise and Nutrition Alternatives (ATHENA) program is a formalized substance abuse and disordered eating prevention program for adolescent female athletes
 - In 1 prospective controlled trial ATHENA resulted in significantly less ongoing and new use of diet pills and less new use of athletic-enhancing substances ($P < 0.05$)¹¹
3. Random drug testing may be considered a prevention strategy, but only 13% of schools test athletes, and of these schools only 29% specifically test for AAS⁶
 - Random school drug testing in athletes compared to non-athletes may result in reduction in past 30-day use of illicit drugs and PEDs ($p < 0.05$) but increased drug use risk factors ($p < 0.05$) including norms of use and poor attitudes toward efficacy of drug testing and the school (cohort, $n = 783$)¹²
 - The Student Athlete Testing Using Random Notification (SATURN) study surveyed students in a drug and alcohol testing program which also tested for AAS in half the samples (RCT, $n = 1396$)
 - Surveyed students
 - Had less belief in their own athletic competence ($p < 0.001$)
 - Believed less in the benefits of testing ($p < 0.05$)
 - Believed that authorities were less opposed to drug use ($p < 0.001$)
 - Believed less that testing was a reason not to use drugs ($p < 0.01$)
4. Physician sponsored prevention interventions are directed at individual patient encounters
 - Acknowledge both benefits and risks of AAS use
 - Recommending a sports nutritionist may help adolescents make better food choices to optimize their health and performance¹
 - Provide alternatives to adolescent athletes' athletic goals
 - Pediatric strength training for 8 year olds is endorsed by the American College of Sports Medicine as a safe and effective method of increasing baseline strength and improving athletic performance⁷

- "Scare tactics" by the primary physician strategy has been shown to weaken physician credibility and even encourage use⁶
- 5. Anti-anabolic steroid literature is readily accessible and can be used as a tool by physicians
 - Less effective than formalized team-centered prevention programs such as ATLAS and ATHENA

Patient Education

1. www.familydoctor.org: Steroid use
2. <http://familydoctor.org/online/famdocen/home/children/parents/parents-teens/steroids.html>

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