Overview

- Developed in the late 1930's for hypogonadism
  - Is a lack of testosterone by the testes
  - Used to treat
    - Delayed Puberty
    - Impotence
    - Body wasting syndrome

Side Effect

- Also found anabolic steroids increased the growth of skeletal muscle in animals.
- Result
  - Were used by bodybuilders and other athletes to increase muscle mass.
  - Has influence sports outcomes.
  - Banned by many sports organizations

Epidemiology

- More prevalent among males than females.
- More females are using now than before
- 1.4% of young adults (19-28) reported using steroids in their lifetime.
- Among 19-22 year olds, 18.9% reported they had a friend who used steroids

Reasons for Use

- Improve sports performance
  - Used extensively in bodybuilding
- Increase muscle size
- Increase lean body mass
- Increase strength
- Reduce body fat
- Use for protection
  - Many steroid abusers report past physical or sexual abuse.
  - Abusers believe the bigger and stronger you are, the lower incidence of future attacks.

Overall

- Use to make you look more attractive.
- Use to improve athletic performance.
**Medically used for**
- Decreasing weight loss in renal failure patients undergoing hemodialysis
- HIV Positive patients
  - Reduces weight loss
  - Improves libido and energy
  - Improves mood
  - Increases muscle mass
- Blood anemia's
- Fibrocystic disease of the breast in females
- Aspects of malnutrition
- Others

**Also Used for**
- Treatment of catabolic states resulting from
  - Trauma
  - Surgery
  - Others

**Types of Anabolic Steroids**
- Over 100 different types
  - Does not include dietary supplements
- Most are similar in structure
- Major differences in relation to metabolic degradation by the liver.
- Oral
- Injection

**Oral Steroids**
- Anavar (Oxandrolone)
- Anadrol-50 (Oxymetholone)
- Oxandrin (Axandrolone)
- Dianabol (Methandrostenolone)
- Winstrol (Stanozolol) (Vet)
- Primobolan (Methenolone)
- Others

**Injectable Steroids**
- Deca-Duraboli (Nandrolone Decanoate)
- Durabolin (Nandrolone Phenpropionate)
- Depo-Testosterone (Testosterone Cypionate)
- Equipoise (Boldenone Undecylenate)

**OTC Dietary Supplements**
- Some people believe they have anabolic effects.
- Are designed to be converted into testosterone or similar compounds.
  - Are precursors
- Can be purchased without a prescription.
  - Dehydroepiandrosterone (DHEA)
  - Androstenedione (Andro) (Mark McGwire)
Effectiveness of Dietary Supplements

- Unknown if conversion to testosterone is enough to develop muscle growth
- Minimal information is known about side effects.
- If you do get effects from high doses, the same side effects will occur as with steroids.
- No real regulation on dietary supplements.

Another Problem

- Many substances sold as anabolic steroids are:
  - Diluted - Gives dealers more profit
  - Contaminated with other compounds
  - Placebo’s - Fake

Methods of Use

- Oral
  - Pill form
- Injection
  - Usually IM not IV
  - Give in the gluteus maximus (butt muscle)
  - Usually with clean needles
  - Needle sharing not as common as with other drugs

Needle Sharing is Dangerous

- Hepatitis
- HIV
- Other Problems

Dosage Levels

- People often take significantly more than medically recommended dosages
- Often take more than needed to get an effect
  - More is better
- Often combine multiple types of steroids (stacking)
  - Designed to boost the effectiveness
- May use a cycle technique
  - Take for a few weeks, stop for a few weeks, then repeat.

Do Steroids Work?

- Depends
  - Mixed studies
- Do get increased muscle mass
  - Get increased strength
- Get increased strength with fast muscle groups
- Get increased endurance for workouts
- Is less effective for prolonged performance tasks
  - Distance running
- Does not help with aerobic performance
**Problem**
- Lots of studies
- Many are poorly done with poor controls
- With confounds – get mixed results.

**Don't know effectiveness for**
- Improved agility
- Improved skill
- Improved cardiovascular capacity
- Overall athletic performance.

- Reports say steroids work, controlled studies don't get the same results in all cases.

**Generally**
- Increase the size and strength of a person.
- Improves athletic activities that require size and strength
- Again, no positive effects on aerobic performance

**Three Effects from Steroids**
- Anticatabolic Effects
- Anabolic Effects
- Motivational Effects

**Anticatabolic Effects**
- Cortisone
  - Cortisone functions to increase energy stores during stress and training
  - Breaks down proteins to their amino acids
  - Too much cortisone, muscle wasting can occur.
  - Reason too much of a workout is actually bad for you.

**Result**
- Steroids block the breakdown process of cortisone
- May be the reason for development of body mass
**Anabolic Effects**

- Follows the synthesis of new protein in muscle cells
- Also causes steroid-induced release of endogenous growth hormone
- Problem
  - Doses used by athletes are 10-200 times the therapeutic dosage for normal testosterone deficiency

**Motivational Effects**

- Effects are huge
- Develop aggressive personalities
  - Called Roid Rage
- Can be beneficial in sports involving strength and combativeness
  - Football

**Result**

- To get effects
  - You need to stack or pyramid several drugs.
  - Combine oral and injectable substances through cycles of weeks duration

**Females**

- Steroids exert the same effects as in males
- Induce female masculinizing effects
  - Increased body hair
  - Enlarged clitoris
  - Coarser skin
  - Voice changes
  - Menstrual cycle cessation or irregularity
  - Others

**Ceasing Use?**

- Is variable
- Often there is an incomplete return of altered functions after stopping
- Many side effects continue

**Non Athletes**

- Est. 200,000-500,000 young adults use steroids
- Used to develop
  - Muscular physique
  - Sex appeal
  - Physical attractiveness
- Problem, continue to use for much longer periods than athletes to maintain appearance
- Underestimate steroid problems and side effects
How do they work

- Mimics or stimulate testosterone types of hormones.
- Thus, bind on receptors in the brain, or in the testicles.

Pharmacokinetics

- Oral administration
- Is absorbed in from the intestine
- Goes to the liver
  - Is immediately metabolized to androstanolone
    - Is the most active anabolic substance
  - Result - Minimal amounts reach the systemic circulation to reach the brain.

Injection

- Gets around this process. More gets into circulation before being metabolized by the liver.

Change the Compound Structure

Reason there are so many types
- Reduces the metabolic degradation
- Improves the effectiveness of both administration routes.

Testosterone

- Is the primary male sex hormone
- Is made in Leydig cells of the testes
- Is tightly regulated by the
  - Testes
  - Hypothalamus
  - Pituitary gland

Administration

- Decreases sizes of
  - Thymus
  - Adrenal glands
  - Spleen
  - Lymph glands
- All involved with immune system functioning
When Testosterone Levels are Decreased

- Is sensed by receptors in the hypothalamus
- Hypothalamus begins producing a releasing factor
  - Called Gonadotropin-Releasing Factor (GRF)
- GRF circulates in the blood and goes to the Pituitary Gland

Stimulates the Pituitary to Release

- Follicle-Stimulating Hormone (FSH)
  - In Females
- Luteinizing Hormone (LH)
  - In Males
  - Acts on the testes to
    - 1. Induce production of sperm
    - 2. Cause the synthesis and release of testosterone.

As Testosterone Levels Increase

- Hypothalamus decreases the production of gonadotrophin-releasing factor.
- Get reductions of FSH and LH
- Testes decrease production of testosterone
- Process repeats

Introduction of Steroids

- Overwhelms the system
- High levels decrease natural production of
  - GRF
  - FSH and LH
  - Testosterone
  - Decreases spermatogenesis

Pharmacodynamics

- Passes through cell walls of target tissues
- Attaches to steroid receptors in the cytoplasm of the cell wall.
- Hormone receptor complex is translocated into the nucleus
- Attaches to DNA
- Makes new messenger RNA
- RNA results in the production of specific proteins
  - Protein synthesis
- Proteins leave the cell and mediate the biological functions of the hormone
**Ultimately**

- Blocks the normal process that regulates testosterone
  - Male fertility
  - Sperm Production
- Exerts peripheral hormone actions to increase muscle mass and more masculine appearance
- Increases aggression

**How do Steroids Decrease GRF**

**Action**

- Compounds bind on specific receptor binding sites.
- Cause nerve cells to fire or structures to secrete hormones.

**Downregulation**

- Over time have fewer receptors
- Takes more drug to get the same effect.
- Occurs in the testes
- Called tolerance.
- Need to increase the steroid level

**Problem**

- High levels shut down the hypothalamus
- Less production of hormonal release
- Less stimulation of testosterone by the testes
- Need more drug.
- Repeat
Side Effects

Brain Effects
- Can occur even in adults
- Changes the size of soma's (cell body)
- Changes the volume of some brain structures - e.g., hypothalamic nuclei

Musculoskeletal Effects
- Does increase muscle mass
- Get tendon degeneration
  - Increased risk of tendon tears
- Begin use to early, get premature closure of bony growth centers.
  - You may look good, but you are also shorter than you would be.

Liver Effects
- Increased liver enzymes
- Jaundice
- Liver tumors
  - Benign
  - Malignant (>24 months use)
- Peliosis Hepatis
  - Is rare
  - Are blood filled cysts that form in the liver.
  - Can rupture causing internal bleeding

Cardiovascular Effects
- All steroids
  - Decrease good cholesterol (HDL)
  - Increase bad cholesterol (LDL)
- Result
  - Hypertension
  - Increased plaques in arteries
  - Increased risk of strokes
  - Increased risk of heart attacks

Reproductive Effects
- Hypogonadal State
  - Decreased testosterone production
  - Abnormal spermatogenesis
  - Infertility
  - Testicular atrophy
  - Decreased libido
  - Impotence
  - Painful urination
  - Enlarged Prostate
  - Often are reversible when use stops
Females
- As before
- Also get smaller breasts
- Offspring problems if pregnant and using and are irreversible

Gynecomastia
- Enlargement of the breasts in males
- Is a side effect of steroids being metabolized
  - Converted to Estradiol

Others
- Reduced immunity to diseases
- Decreased thyroid functioning
- Acne
- Acceleration of male pattern baldness

Other Medical Conditions
- Infections due to non-sterile technique
  - Abscess Formations
- Development may be non-sterile as well.
- Can develop viral infections
  - Hepatitis B, C
- Endocarditis
  - Inflammation of the heart lining
  - Can be fatal

Psychological Issues
- Can get euphoria - Increases addiction potential
- Increased risks of habituation
- Severe mood swings
- Increased mania
- Increased aggression
- Psychotic episodes
- Depression/Suicide

Pope
- Gave a six week trial of testosterone in 56 males increasing the dosage to 600mg
- Dosages to 300mg - few effects
- Dosages 500-600mg - prominent effects in 12% of the individuals.
Problem
- Users in the real world, may be taking higher dosages
- Effects are delayed from time of use
  - Synthesizing new proteins takes a few days.
- Effects on hypothalamus
  - Part of the limbic system - controls emotions

Jekyll-Hyde Personality
- Is a common occurrence
- Slight provocation can cause
  - Exaggerated, violent, and **OFTEN UNCONTROLLED** responses
- Are reversible

Other Psychological Syndromes
- Paranoid Jealousy
- Extreme irritability
- Delusions
- Feelings of invincibility
- May also get
  - Euphoria
  - Sexual arousal
  - Forgetfulness/Confusion

Other Risks
- Increased risk of using other drugs
- When combined with alcohol or cocaine, often get increases of aggressive behavior.

Stopping Use
- Get withdrawal syndrome
- Often people become
  - Clinically depressed
  - Decreased sexual desire
  - Fatigue

Why do People Stop
- Mature out
Conclusions

- Does have positive effects when used medically for several problems
- Many negative effects if used incorrectly
- Causes lots of problems