S1

S1 ANABOLIC AGENTS

- **1. ANABOLIC ANDROGENIC STEROIDS (AAS)**
- **a. Exogenous* AAS**
- **b. Endogenous** AAS**

- **2. OTHER ANABOLIC AGENTS**

- **For purposes of this section:**
- An **androgen** is any natural or synthetic steroid hormone that regulates the development and maintenance of male characteristics in vertebrates by binding to androgen receptors.
- * " **exogenous**" refers to a substance which is not ordinarily produced by the body naturally.
- ** " **endogenous**" refers to a substance which is ordinarily produced by the body naturally.

Exogenous AAS

- 1-Androstenediol (5α-androst-1-ene-3β,17β-diol);
- 1-Androstenedione (5α-androst-1-ene-3,17-dione);
- 1-Androsterone (3α-hydroxy-5α-androst-1-ene-17-one);
- 1-Testosterone (17β-hydroxy-5α-androst-1-en-3-one);
- 4-Hydroxytestosterone (4,17β-dihydroxyandrost-4-en-3- one);
- Bolandiol (estr-4-ene-3β,17β-diol);
- Bolasterone;
- Calusterone;
- Clostebol;
- Danazol ([1,2]oxazolo[4',5':2,3]pregna-4-en-20-yn-17α-ol);
- Dehydrochlormethyltestosterone (4-chloro-17β-hydroxy- 17α-methylandrosta-1,4-dien-3-one);
- Desoxymethyltestosterone (17α-methyl-5α-androst- 2-en-17β-ol);
- Drostanolone;
- Ethylestrenol (19-norpregna-4-en-17α-ol);
- Fluoxymesterone;
- Formebolone;
- Furazabol (17α-methyl [1,2,5] oxadiazolo [3',4':2,3]-5α- androstan-17β-ol);
- Gestrinone;

Exogenous AAS

- Mestanolone;
- Mesterolone;
- Metandienone (17β-hydroxy-17α-methylandrosta-1,4-dien- 3-one);
- Metenolone;
- Methandriol;
- Methasterone (17β-hydroxy-2α,17α-dimethyl-5α-androstan-3-one);
- Methyldienolone (17β-hydroxy-17α-methylestra-4,9-dien- 3-one);
- Methyl-1-testosterone (17β-hydroxy-17α-methyl-5α- androst-1-en-3-one);
- Methylnortestosterone (17β-hydroxy-17α-methylestr-4-en- 3-one);
- Methyltestosterone;
- Metribolone (methyltrienolone, 17β-hydroxy-17α- methylestra-4,9,11-trien-3-one);
- Mibolerone;
- Norboletone;
- Norclostebol;
- Norethandrolone;
- Oxabolone;
- Oxandrolone;
- Oxymesterone;
- Oxymetholone;
- Prostanozol (17β-[(tetrahydropyran-2-yl)oxy]- 'Hpyrazolo[3,4:2,3]-5α-androstane);

Exogenous AAS

- **Q**uinbolone;
- **S**tanozolol;
- Stenbolone;
- **T**etrahydrogestrinone (17-hydroxy-18a-homo-19-nor-17α- pregna-4,9,11-trien-3-one);
- Trenbolone (17β-hydroxyestr-4,9,11-trien-3-one);

- and other substances with a similar chemical structure or similar biological effect(s).

Endogenous AAS when administered exogenously

- **19-N**orandrostenediol (estr-4-ene-3,17-diol);
- 19-Norandrostenedione (estr-4-ene-3,17-dione);
- **A**ndrostanolone (5α-dihydrotestosterone, 17β-hydroxy-5α-androstan-3-one);
- Androstenediol (androst-5-ene-3β,17β-diol);
- Androstenedione (androst-4-ene-3,17-dione);
- **B**oldenone;
- Boldione (androsta-1,4-diene-3,17-dione);
- **N**androlone (19-nortestosterone);
- **P**rasterone (dehydroepiandrosterone, DHEA, 3β-hydroxyandrost-5-en-17-one);
- **T**estosterone;
- and their metabolites and isomers, including but not limited to:
- 3β-Hydroxy-5α-androstan-17-one;
- 5α-Androst-2-ene-17-one;
- 5α-Androstane-3α,17α-diol;
- 5α-Androstane-3α,17β-diol;
- 5α-Androstane-3β,17α-diol;
- 5α-Androstane-3β,17β-diol;
- 5β-Androstane-3α,17β-diol;

Endogenous AAS when administered exogenously

- 7α-Hydroxy-DHEA;
- 7β-Hydroxy-DHEA;
- 4-Androstenediol (androst-4-ene-3β, 17β-diol);
- 5-Androstenedione (androst-5-ene-3,17-dione);
- 7-Keto-DHEA;
- 19-Norandrosterone;
- 19-Noretiocholanolone;
- Androst-4-ene-3α,17α-diol;
- Androst-4-ene-3α,17β-diol;
- Androst-4-ene-3β,17α-diol;
- Androst-5-ene-3α,17α-diol;
- Androst-5-ene-3α,17β-diol;
- Androst-5-ene-3β,17α-diol;
- Androsterone;
- Epi-dihydrotestosterone;
- Epitestosterone;
- Etiocholanolone.

Endogenous AAS when administered exogenously

- 7α-Hydroxy-DHEA;
- 7β-Hydroxy-DHEA;
- 4-Androstenediol (androst-4-ene-3β, 17β-diol);
- 5-Androstenedione (androst-5-ene-3,17-dione);
- 7-Keto-DHEA;
- 19-Norandrosterone;
- 19-Noretiocholanolone;
- Androst-4-ene-3α,17α-diol;
- Androst-4-ene-3α,17β-diol;
- Androst-4-ene-3β,17α-diol;
- Androst-5-ene-3α,17α-diol;
- Androst-5-ene-3α,17β-diol;
- Androst-5-ene-3β,17α-diol;
- Androsterone;
- Epi-dihydrotestosterone;
- Epitestosterone;
- Etiocholanolone.

OTHER ANABOLIC AGENTS

Including, but not limited to:

- Clenbuterol
- selective androgen receptor modulators (SARMs, e.g. andarine, LGD-4033 ostarine and RAD140)
- tibolone
- zeranol and zilpaterol

کلنبوترول

- می تواند باعث افزایش سرعت متابولیسم و چربی سوزی، تنفس بهتر و تحریک سنتز پروتئین در عضلات شود.
- می تواند باعث افزایش ناگهانی فشار خون شود. همین امر می تواند باعث افزایش احتمال بروز هایپرتروفی بطن چپ شود.
- باعث اختلال در خواب می شود.
- بدن را از پتاسیم تهی می کند.

Selective Androgen Receptor Modulators (SARMs)

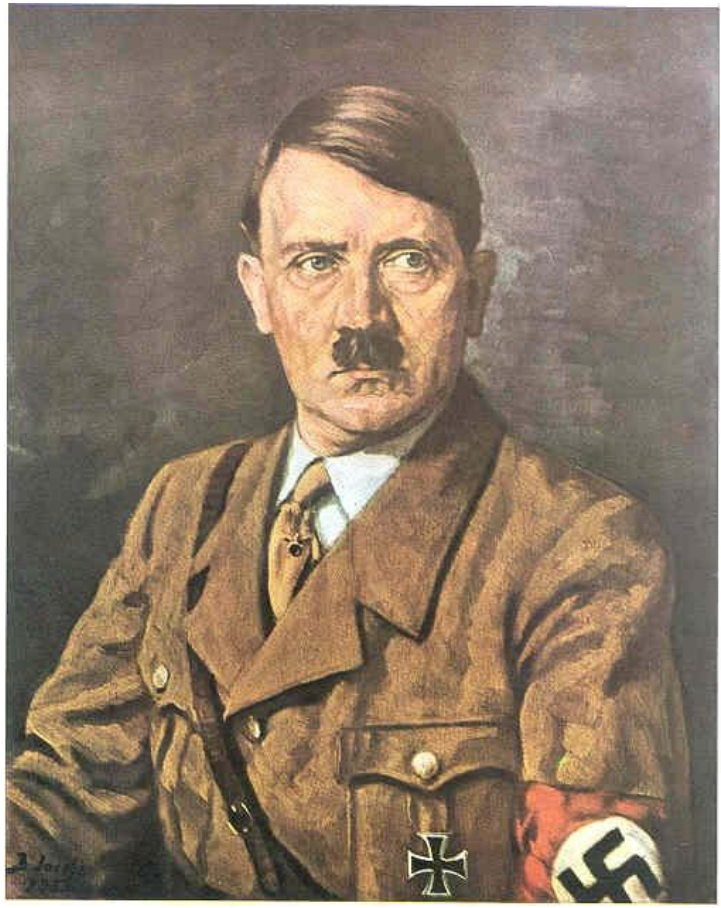
- a class of therapeutic compounds that have similar properties to anabolic agents, but with reduced androgenic properties. This property allows SARMs the advantage of androgen-receptor specificity, tissue selectivity, and the lack of steroid-related side effects.

Tibolone

- Tibolone is a synthetic steroid with weak estrogenic, progestogenic, and androgenic activity, and hence is an agonist of the estrogen, progesterone, and androgen receptors. It is a prodrug of several metabolites. The estrogenic effects of tibolone may show tissue selectivity in their distribution.

History

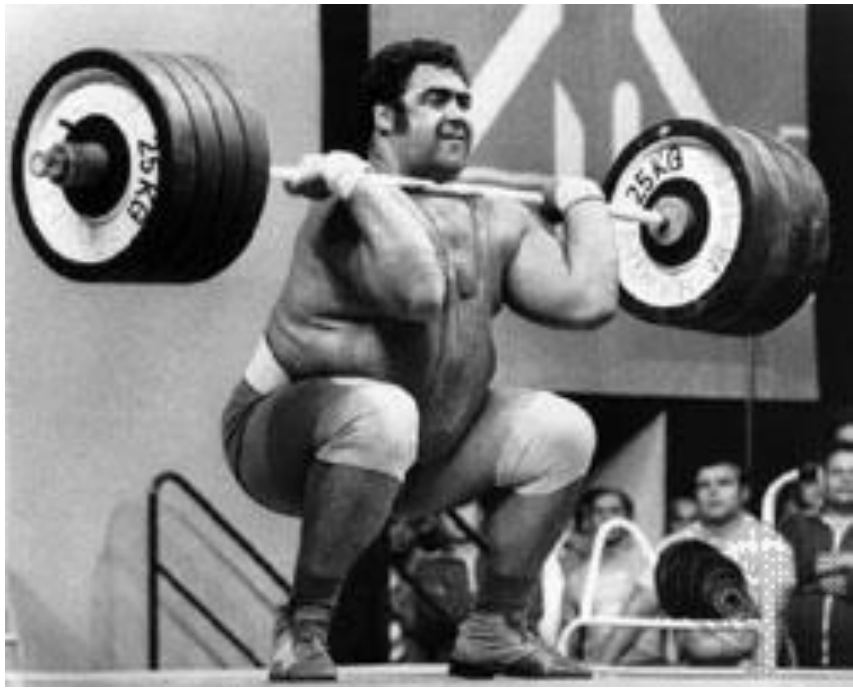
- WWII – German scientists synthesized other anabolic steroids and experimented on concentration camp inmates to treat chronic wasting.
- Also given to German soldiers hoping to increase their aggression.
- Adolf Hitler rumored to take anabolic steroids.



- 1931 – male hormone androstenone isolated
- 1934 – androstenone synthesized
- 1935 – testosterone identified and synthesized
- 1937 – clinical trials on humans with testosterone began

History

- 1940s - Soviet Union and Eastern Bloc Countries (East Germany) established steroid programs in Olympic and amateur weight lifters
- 1958 – Dianabol (methandrostenolone) approved in U.S. by the FDA

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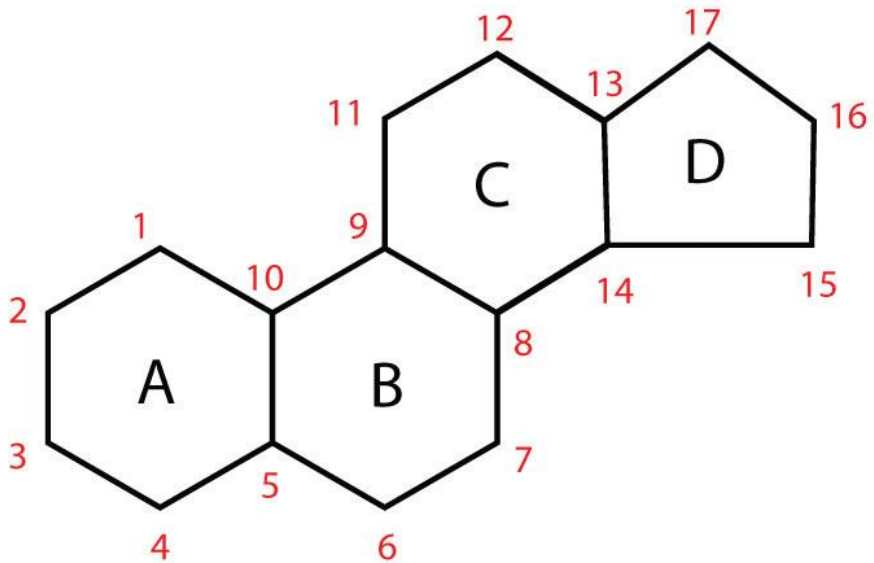
Definitions

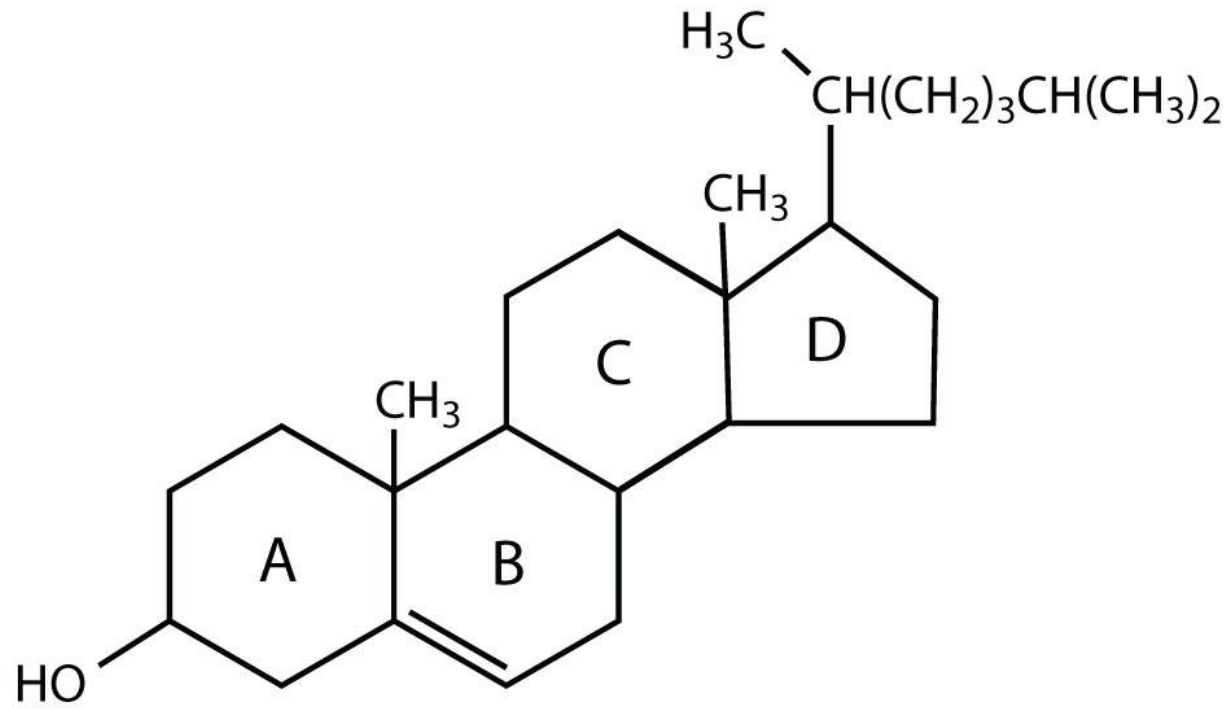
- Androgens: all male sex hormones, usually testosterone, but also testosterone derivatives

- Androgenic: refers to masculinizing properties such as libido, aggression, acne, hair growth and loss
- Anabolic: refers to assimilation of nitrogen into tissue (muscle growth)
- Cannot completely separate one from the other

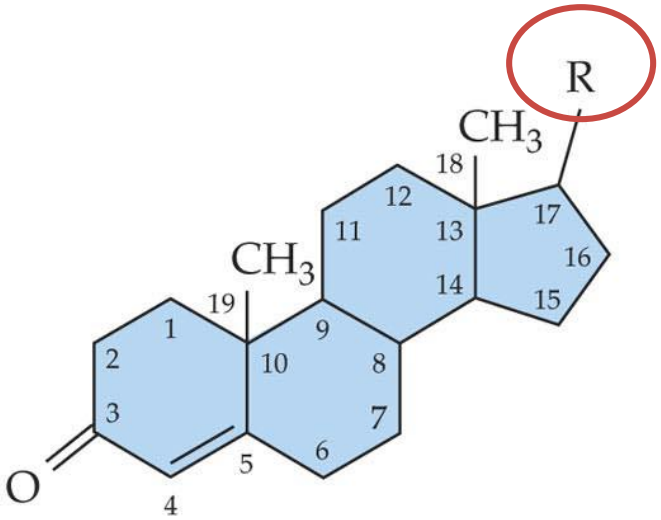
Anabolic steroid	Anabolic/androgenic ratio
Testosterone	1
Methylandrostenediol	2
Oxymetholone	9
Oxandrolone	10
Nandrolone phenpropionate	10
Stanozolol	30



(a) Steroid skeleton

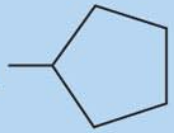


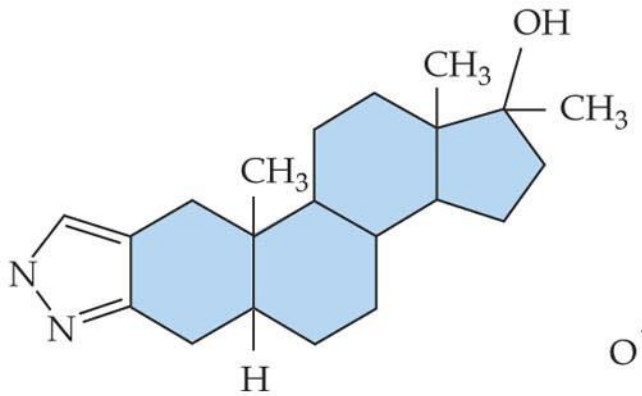
(b) Cholesterol



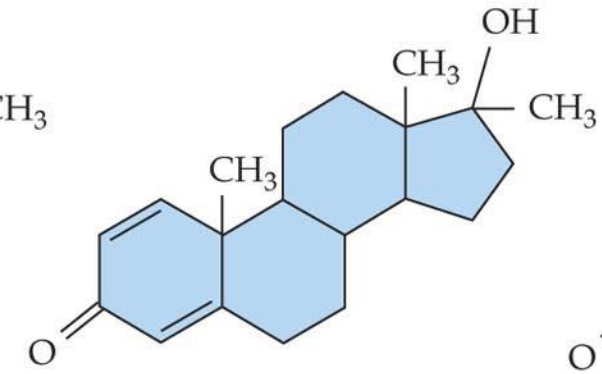
Core structure of testosterone-related steroids

Chemical structures of some commonly abused anabolic steroids

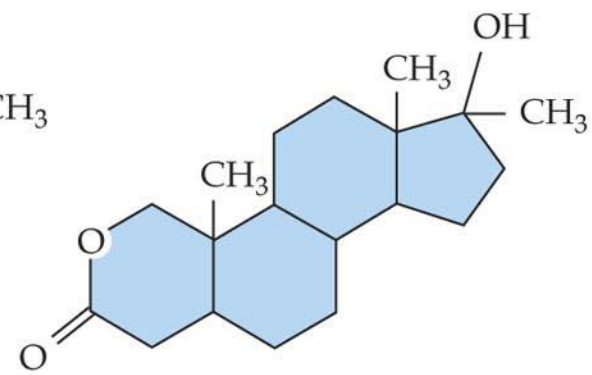
Compound	R
Testosterone	— OH
Testosterone enanthate	— O — $CO(CH_2)_5CH_3$
Testosterone undecanoate	— O — $CO(CH_2)_9CH_3$
Testosterone cypionate	— O — $COCH_2CH_2$ 
Nandrolone decanoate	— O — $CO(CH_2)_8CH_3$ (no methyl group at position 19)
Nandrolone phenproprionate	— O — $CO(CH_2)_2$  (no methyl group at position 19)



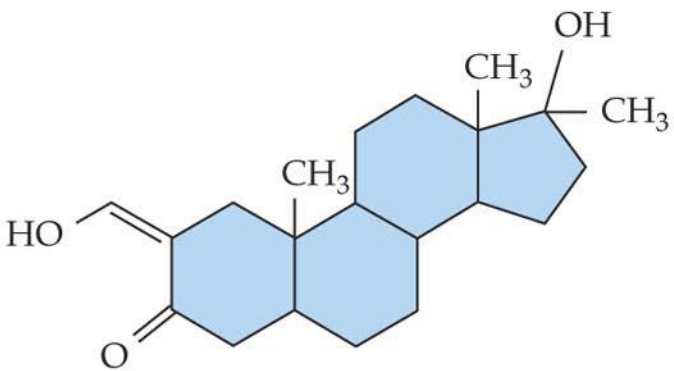
Stanozolol



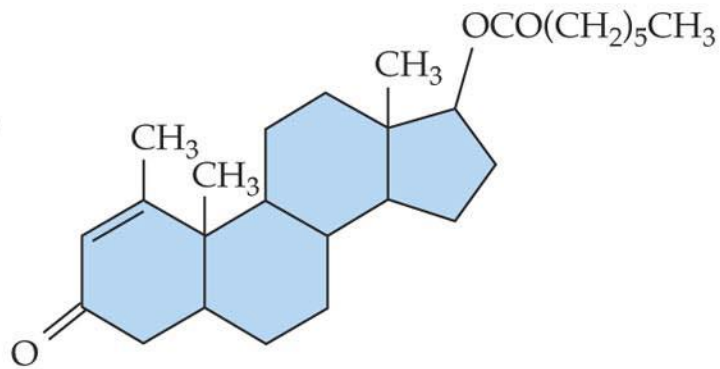
Methandrostenolone



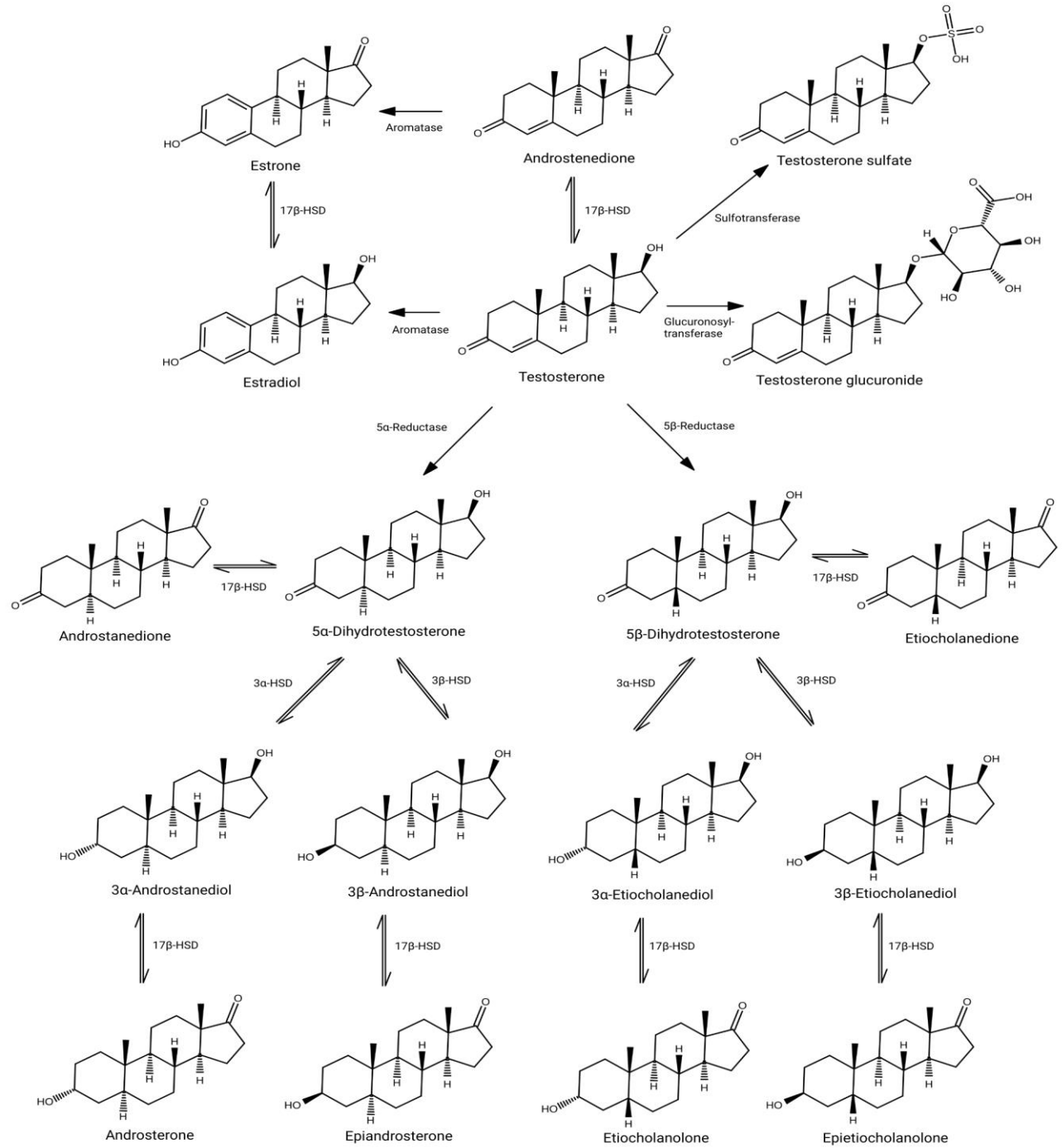
Oxandrolone



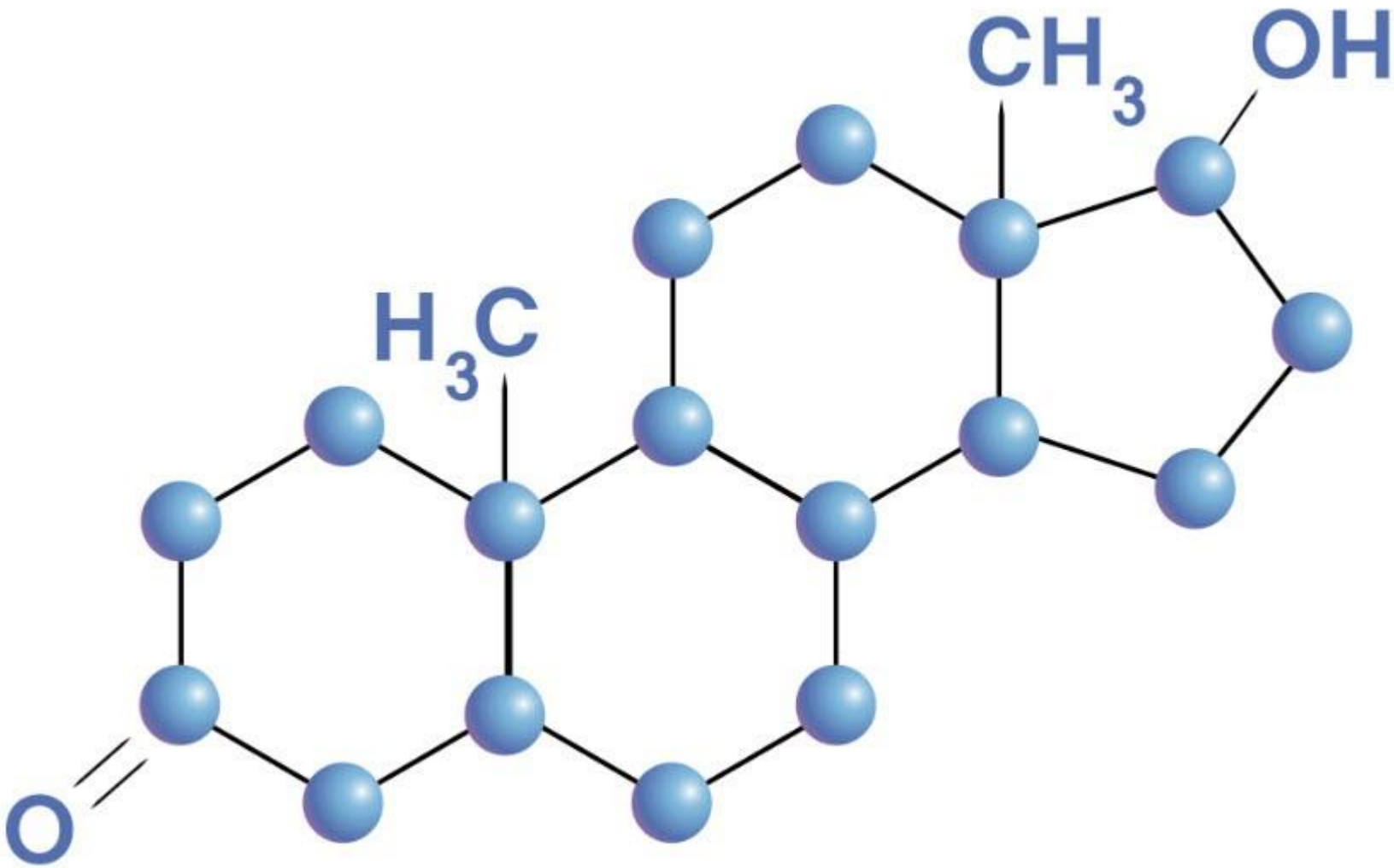
Oxymethalone

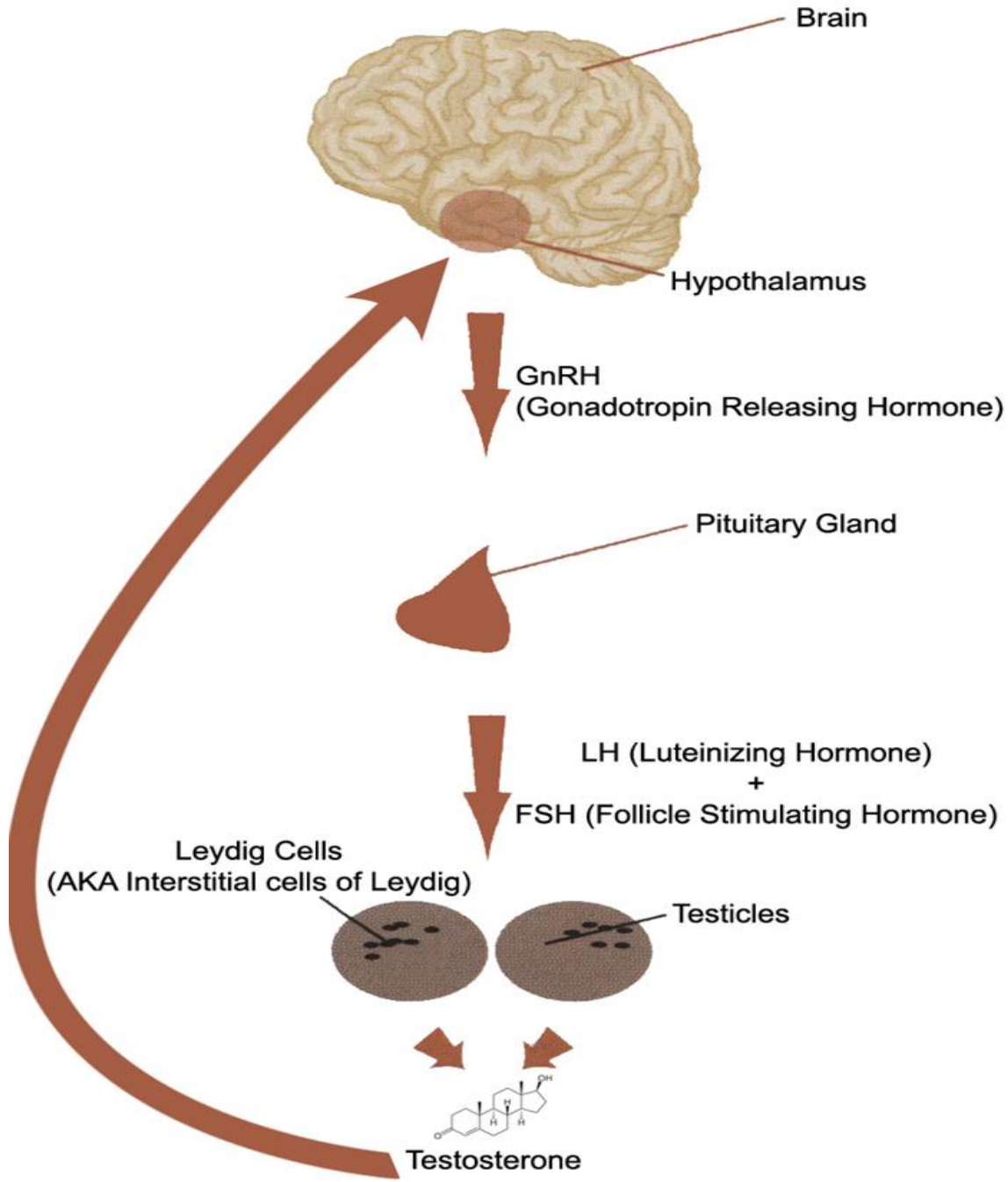


Methenolone enanthate

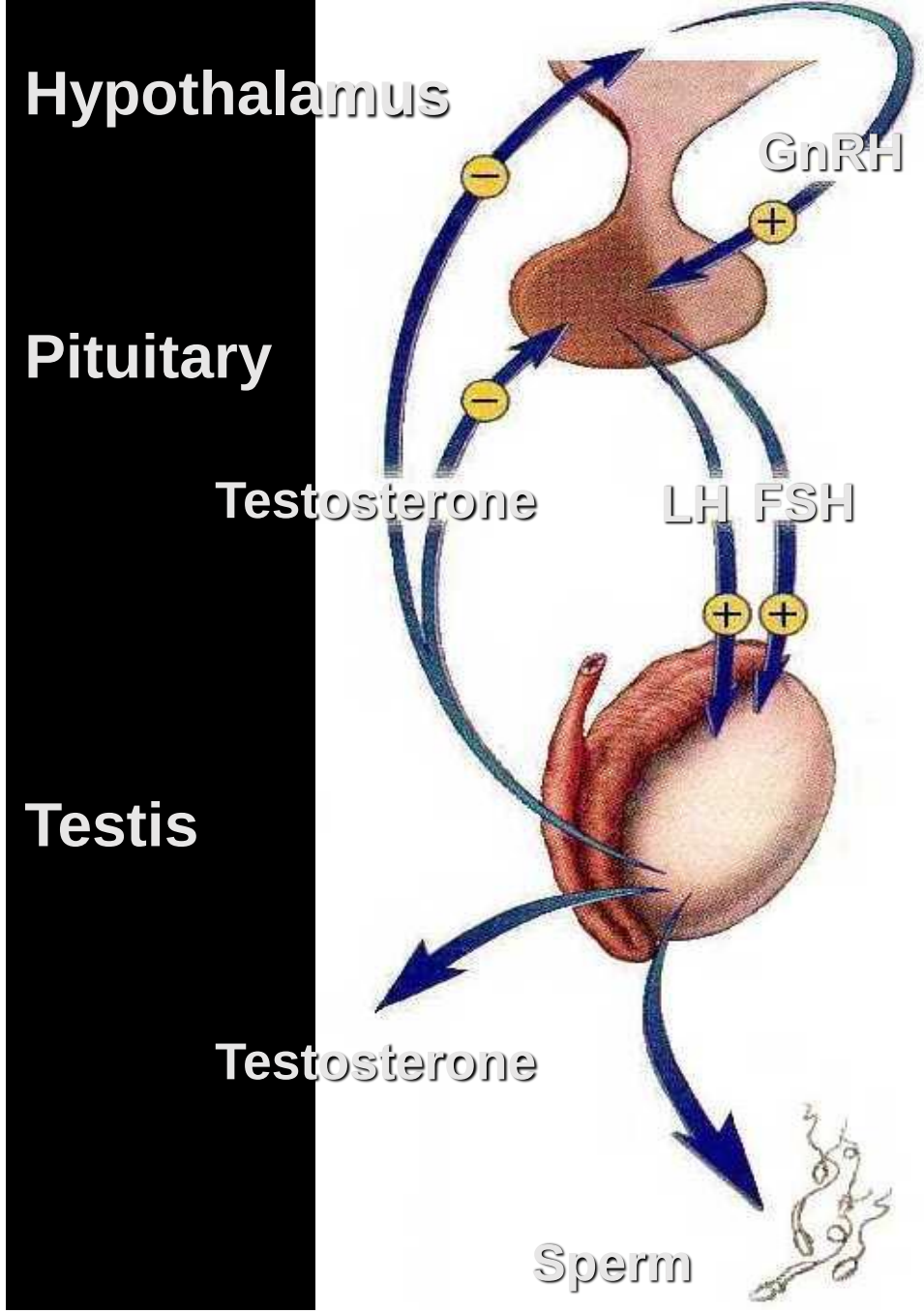

Estrone
Aromatase
Androstenedione
Testosterone sulfate
17β-HSD
17β-HSD
Sulfotransferase
Estradiol
Aromatase
Testosterone
Glucuronosyl-transferase
Testosterone glucuronide
5α-Reductase
5β-Reductase
Androstanedione
17β-HSD
5α-Dihydrotestosterone
5β-Dihydrotestosterone
17β-HSD
Etiocholanedione
3α-HSD
3β-HSD
3α-HSD
3β-HSD
3α-Androstanediol
3β-Androstanediol
3α-Etiocholanediol
3β-Etiocholanediol
17β-HSD
17β-HSD
17β-HSD
17β-HSD
Androsterone
Epiandrosterone
Etiocholanolone
Epietiocholanolone

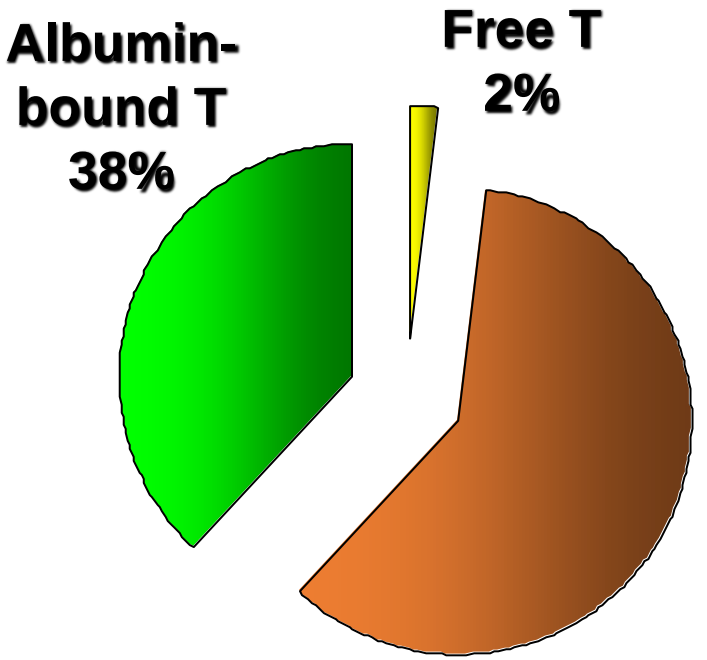
testosterone, 17β-hydroxy-4-androsten-3-one




Brain
Hypothalamus
GnRH
(Gonadotropin Releasing Hormone)
Pituitary Gland
LH (Luteinizing Hormone)
+
FSH (Follicle Stimulating Hormone)
Leydig Cells
(AKA Interstitial cells of Leydig)
Testicles
Testosterone

Production and Regulation of Testosterone





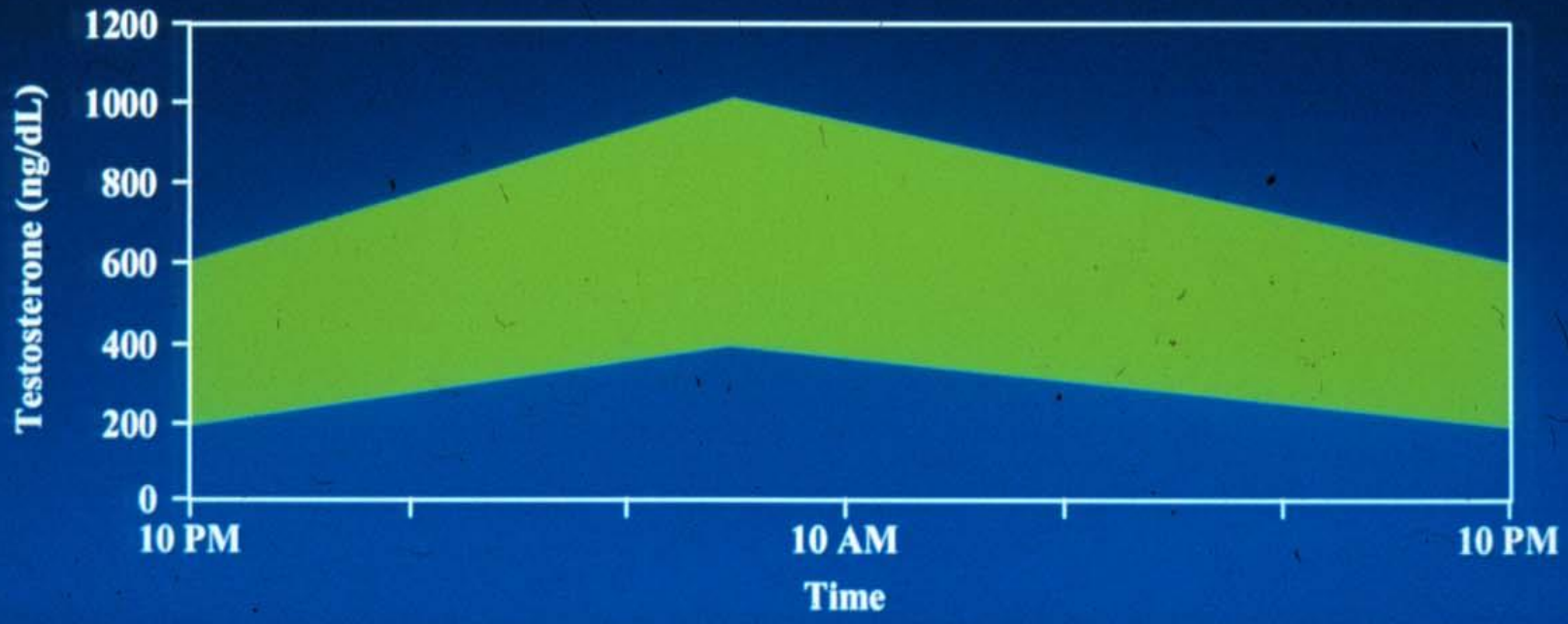
T = testosterone
Only 2% is free testosterone and 98% is bound

Adapted from Bagatell CJ, Bremner WJ. *N Engl J Med*. 1996;334:707-715.

Adapted from Braunstein GD. In: *Basic & Clinical Endocrinology*. 5th ed. Stamford, Conn: Appleton & Lange; 1997:403-433.

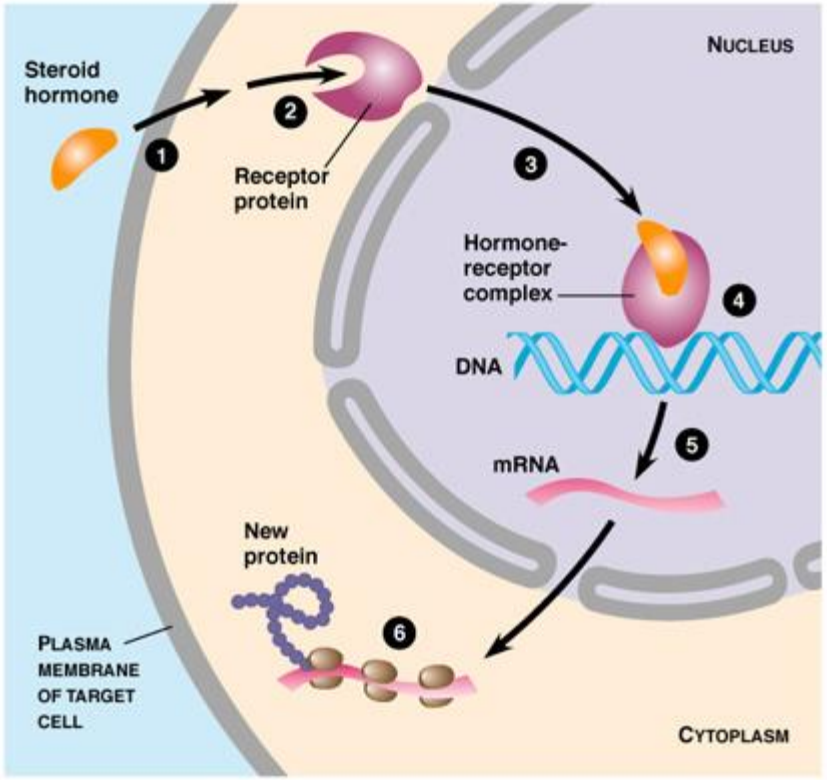
Normal Testosterone Secretion

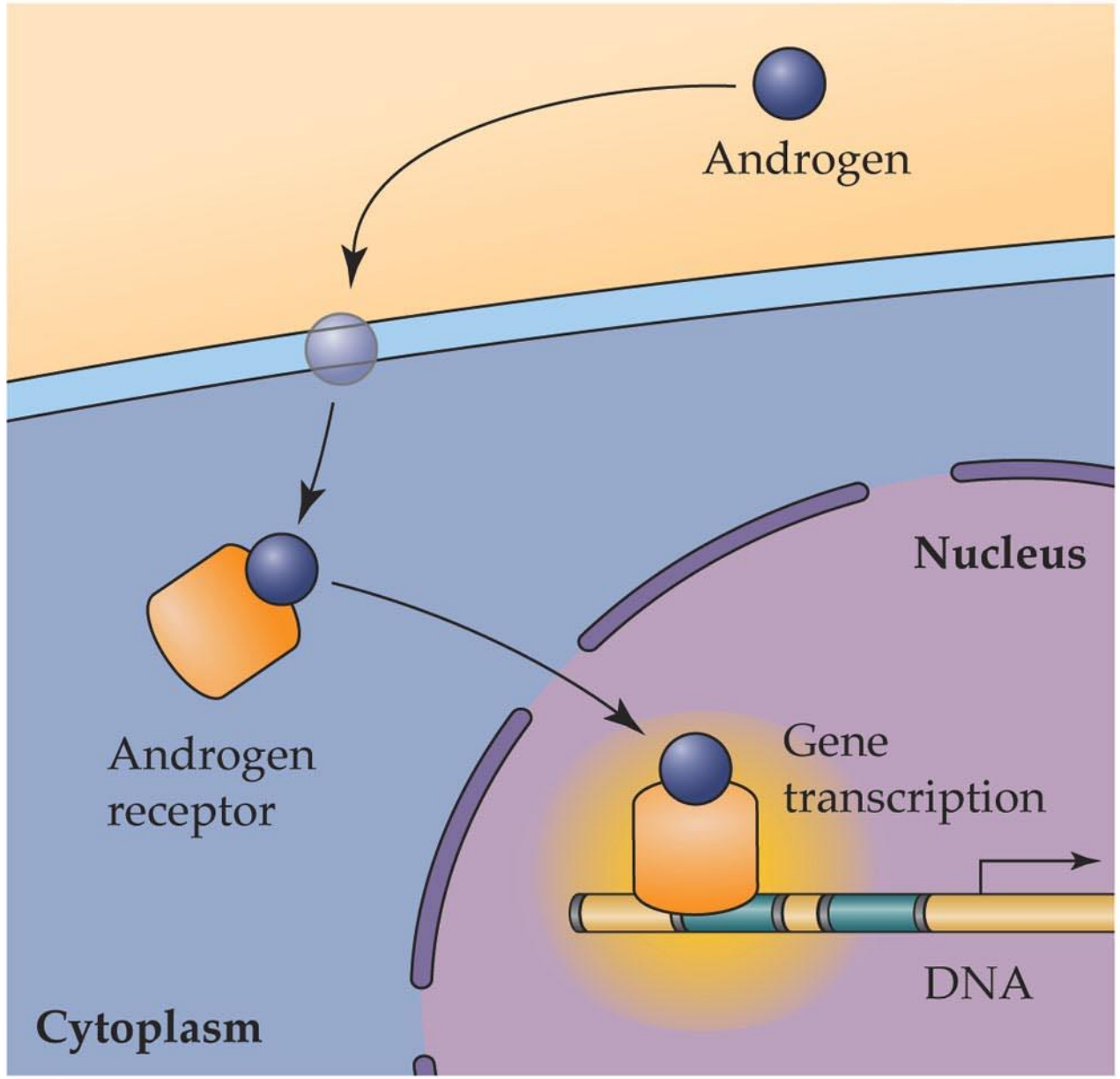
- 3 to 10 mg/day
- Serum concentration ~300 to 1000 ng/dL
- Diurnal Variation - peak in AM, trough in PM



Anabolic Steroids
Biochemical Mechanisms

- Steroid hormones mainly interact with cells by binding to proteins called steroid receptors
- After binding, proteins move into the cell nucleus and can alter the expression of genes or activate processes in other parts of the cell





Testosterone Deficiency with Aging

- Decline in Testosterone with age
  - Decrease in testosterone production
  - Decrease in testosterone clearance
  - Increase in SHBG
    - may be due to higher serum estradiol levels from increased adipose tissue
  - Therefore, bioavailable T decreases more than total T
  - Circadian rhythm (higher T values in AM) lost with aging

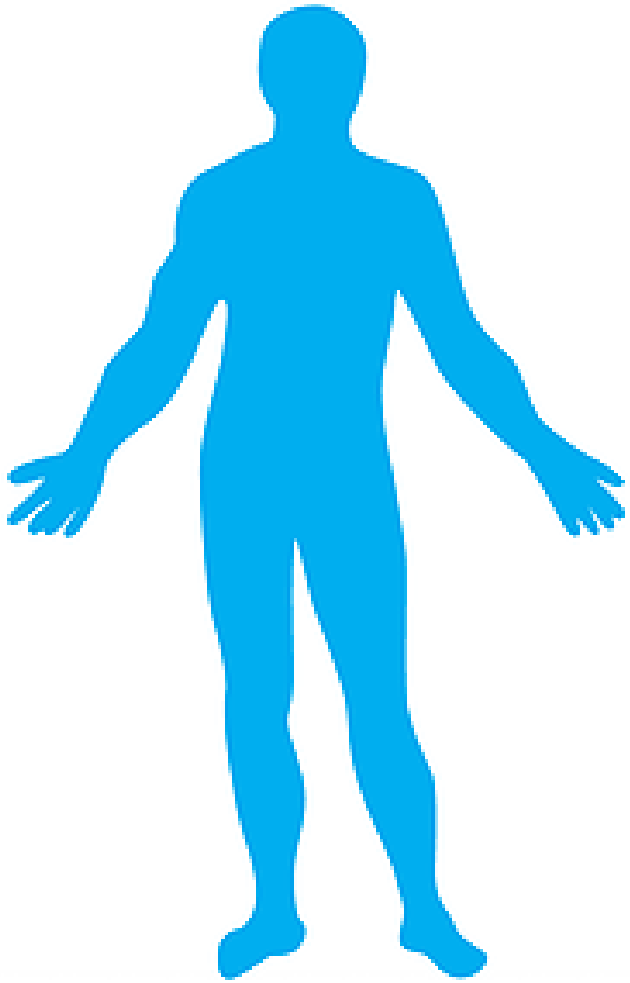
Tenover,L.J. End.Metab.Clinics NA:27,969,1998

The Effects Of Testosterone

Skin:
Hair Growth
Collagen growth

Sex Organs:
Sperm Production
Erektile Function
Prostate Growth

Muscles:
Muscle Growth
Increased Strength
Increased Endurance



Brain:
Increased Sex Drive
Improved Mood
Confidence
Memory function

Bone Marrow:
Red Blood Cell Production

Bones:
Maintenance Of Bone Mass Density

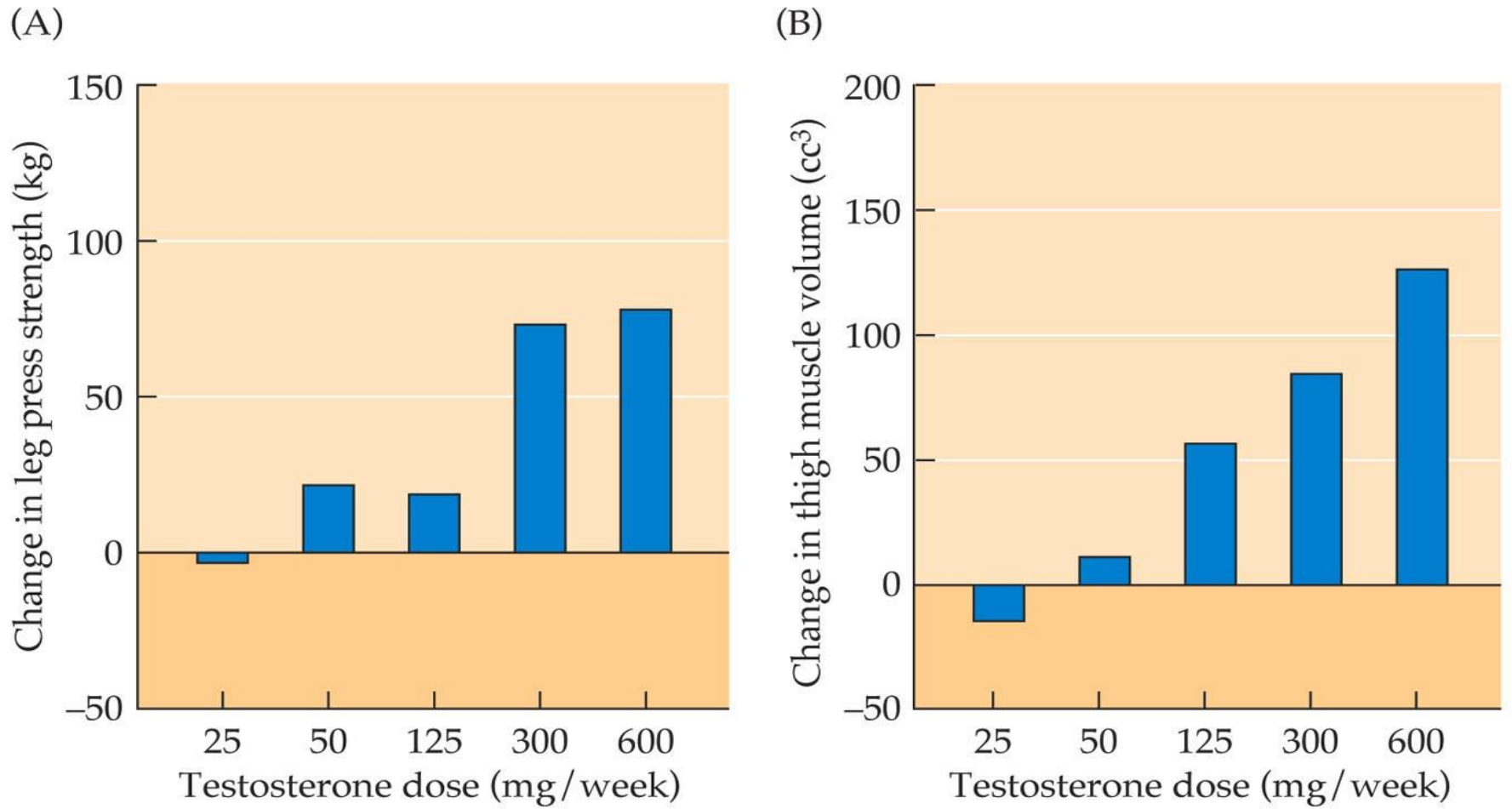
Target Organs and Physiological Effects of Testosterone and Metabolites

- CNS (↑ libido, well-being, aggression, spatial cognition)
- Hypothalamus/ Pituitary (↓ GnRH, LH, FSH; ↑ GH)
- Larynx (lowers voice)
- Breast (E_2 ↑ size)
- Liver (↓ SHBG, HDL)
- Kidney (↑ erythropoietin)
- Genitals (↑ development, spermatogenesis, erections)
- Prostate (↑ size, secretions)
- Skin (↑ facial/ body hair, sebum production)
- Bone (↑ BMD)
- Muscle (↑ lean mass, strength)
- Adipose Tissue (↑ lipolysis, ↓ abdominal fat)
- Blood (↑ hematocrit)
- Immune system (↓ auto-antibody production)

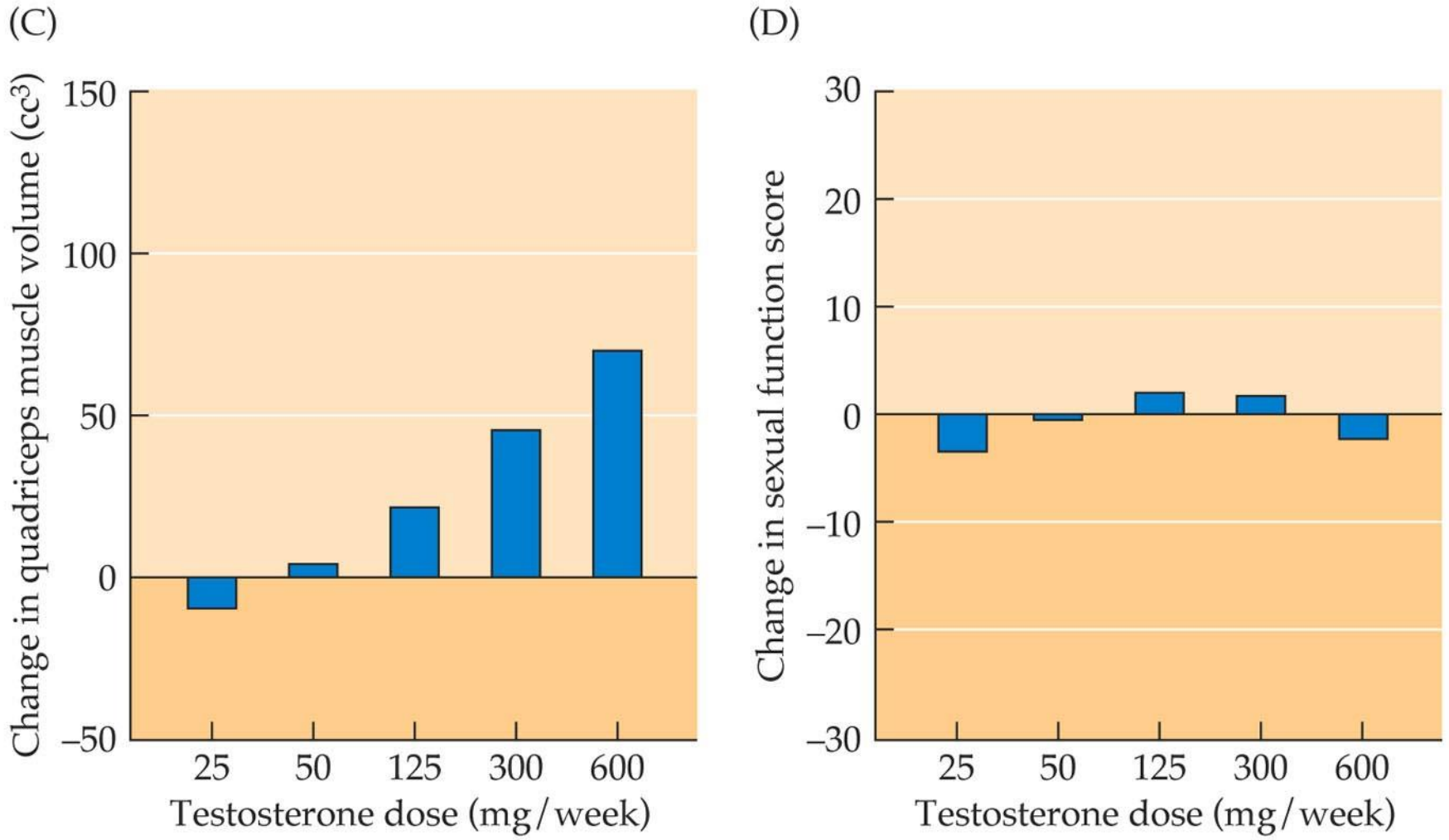
Anabolic Steroids
Medical Uses

- Bone marrow stimulation – aplastic anemia
- Growth stimulation – use GH now
- Appetite stimulate – AIDS, cancer
- Induction of male puberty – extreme delay
- Reversible male contraceptive - future
- Hormone replacement therapy (men)
- Gender dysmorphia - psyciatric

Muscle strength & volume following chronic testosterone administration to men



Muscle strength & volume following chronic testosterone administration to men



Performance enhancement of a former East German female shot-putter

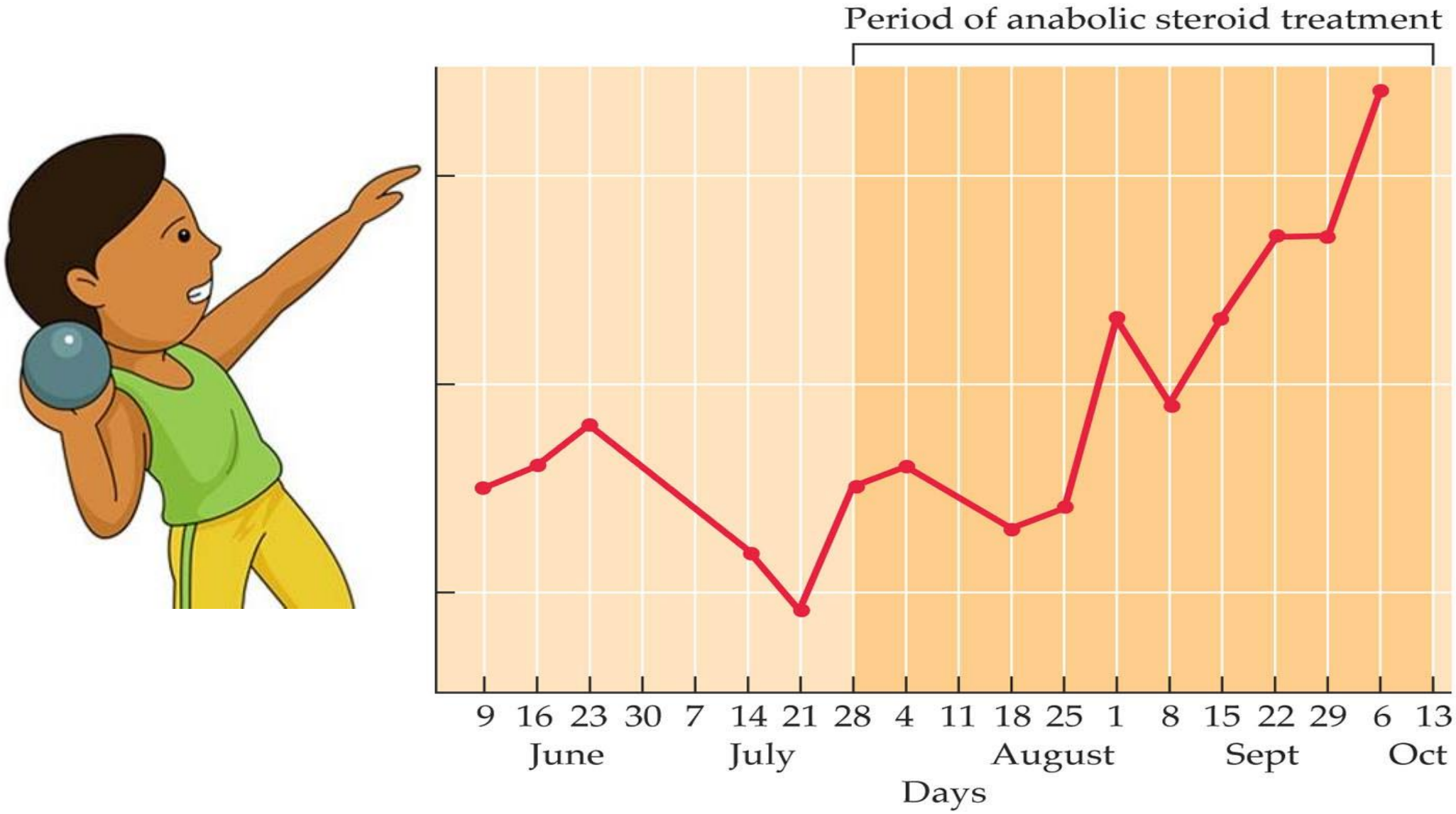


TABLE 15.2 Some Common Anabolic Steroids

Generic name	Trade name	Route of administration
Methandrostenolone	Dianabol	Oral
Testosterone undecanoate	Andriol	Oral
Oxandrolone	Oxandrin	Oral
Oxymetholone	Anadrol	Oral
Stanozolol	Winstrol	Oral or injection
Testosterone cypionate	Depot-Testosterone	Injection
Testosterone enanthate	Primotetson	Injection
Nandrolone phenylpropionate	Durabolin	Injection
Nandrolone decanoate	Deca-Durabolin	Injection
Methenolone enanthate	Primobolan Depot	Injection

Anabolic Steroids Administration

3 common forms of AS administration:

- Oral – most convenient (dangerous - liver)
- Injectable – intramusclar not intravenous (HIV and Hepatitis)
- Transdermal – self adhesive skin patches

شکل مصرف

FORMS

OIL/WATER-BASED INJECTIBLE

PILLS

CREAMS

TRANSDERMAL PATCHES

شیوه مصرف

ROUTES

STACKING

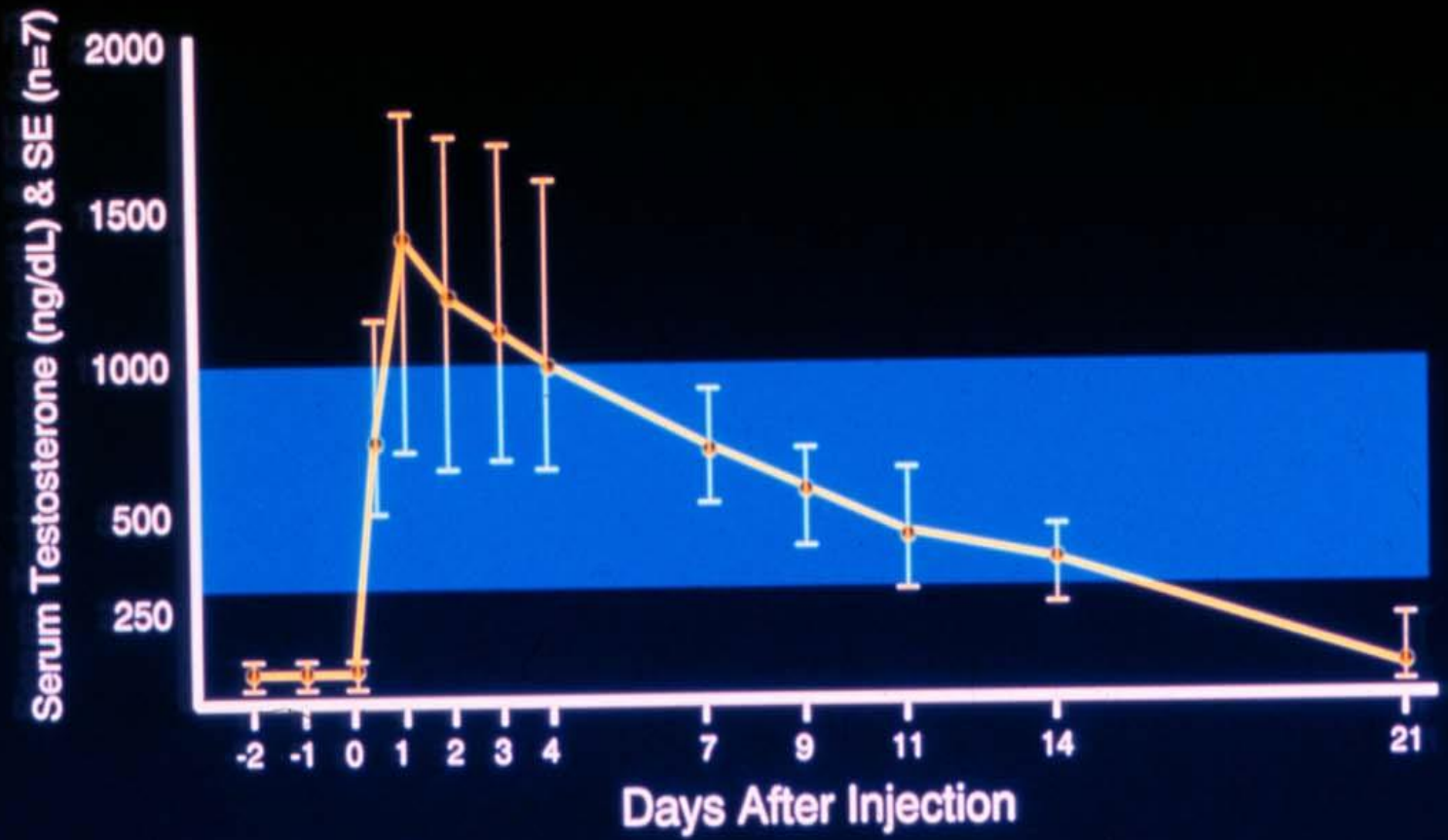
CYCLING

PYRAMIDING

- توده ای: مصرف چند نوع استروئید آنابولیک همزمان به منظور درگیر شدن همه گیرنده ها و اثر بخشی بیشتر
- چرخشی: یک دوره چند هفته ای مصرف و یک دوره چند هفته قطع مصرف. آثار سوء دارو را کم می کند.
- هرمی: به تدریج به اوج می رسد و بعد به تدریج کم می شود. اثر ترک داروی کمتری دارد.

نیمه عمر و زمان تشخیص

Testosterone Serum Levels After Injection



تزریقی ها

نام اختصاصی	نام جنریک	نیمه عمر	زمان تشخیص
Deca-Durabolin	ناندرولون-دکوونات	۱۵ روز	۱۸ ماه
Equipoise	Boldenone Undecylenate	۱۵ روز	۵ ماه
استرسون	دیستنوولون-پروپیونات	۳ روز	۳ هفته
مسترون	Drostanolone Enanthate	۸ روز	۳ ماه
NPP یا Durabolin	تستوسترون-فنیل پروپیونات	۵/۵ روز	۱۸ ماه
Omnadren	۴ مخلوط استر است	۱۵ روز	۳ ماه
پارابولان	Trenbolone-Hexahydrobenzylcarbonate	۶ روز	۵ هفته
انبار پریمو بلوان	متhenolone-Enanthate	۱۰/۵ روز	۵ هفته
Sustanon-250	۴ مخلوط استر است	۱۸ روز	۳-۴ ماه
تستوسترون Cypionate	تستوسترون Cypionate	۱۲ روز	۳ ماه
تستوسترون-Enanthate	تستوسترون-Enanthate	۱۰/۵ روز	۳ ماه
تستوسترون-پروپیونات	تستوسترون-پروپیونات	۳ روز	۳ هفته
تستوسترون سوسپانشن	تستوسترون (بدون استرس)	کمتر از ۲۴ ساعت	۱-۲ روز
Trenbolone-Acetate	Trenbolone-Acetate	۳ روز	۵ ماه

خوراکی

نام اختصاصی	نام جنریک	نیمه عمر	زمان تشخیص
آنادرول	اکسی متولون	کمتر از ۱۶ ساعت	۸ هفته
آنوار	اکساندرولون	۱۲ ساعت	۳ هفته
آندریول	تستوسترون	کمتر از ۱۲ ساعت	۵ هفته
دیانابول	methandrostenolone	۸ ساعت	۶ هفته
هالوتستین	فلوکسیمسترون	۸ ساعت	۸ هفته
پریمو بولان	متیونولون	۶ ساعت	۵ هفته
Proviron	ماستولون	۱۲ ساعت	۶ هفته
تورینابول	۴chlorodehydromethyltestosterone	۱۶ ساعت	۶ هفته
وینسترول	استنزولول	۸ ساعت	۳ هفته

موارد دیگر

Google Translate | anabolic steroids detec | ماندگاری استروئید های آنا | بهترین استروئیدهای آنابول | مدت زمان تست دوپینگ | Boldenone Undecylena

https://www.google.com/search?q=Boldenone+Undecylenate&oq=Boldenone+Undecylenate&aqs=chrome..69i57.1141j0j8&sourceid=chrome&ie=UTF-8

Google

Boldenone Undecylenate

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About 498,000 results (0.35 seconds)

Boldenone undecylenate is an androgen ester and a long-lasting prodrug of **boldenone** in the body. **Boldenone undecylenate** was introduced for medical use in the 1960s. In addition to its medical use, **boldenone undecylenate** is used to improve physique and performance.

Boldenone undecylenate - Wikipedia
https://en.wikipedia.org/wiki/Boldenone_undecylenate

About this result Feedback

People also ask

What is Boldenone Undecylenate used for?

What does boldenone do?

What is Boldenone cypionate?

What is equipoise steroid used for?

Feedback

Boldenone undecylenate

Medication

Boldenone undecylenate, or boldenone undecenoate, sold under the brand names Equipoise and Parenabol among others, is an androgen and anabolic steroid medication which is used in veterinary medicine, mainly in horses. It was formerly used in humans as well. It is given by injection into muscle. Wikipedia

Molar mass: 452.679 g/mol

ChemSpider ID: 10128605

Elimination half-life: Intramuscular: 14 days

PubChem CID: 11954310

People also search for: Boldenone, Drostanolone propionate, MORE

Feedback

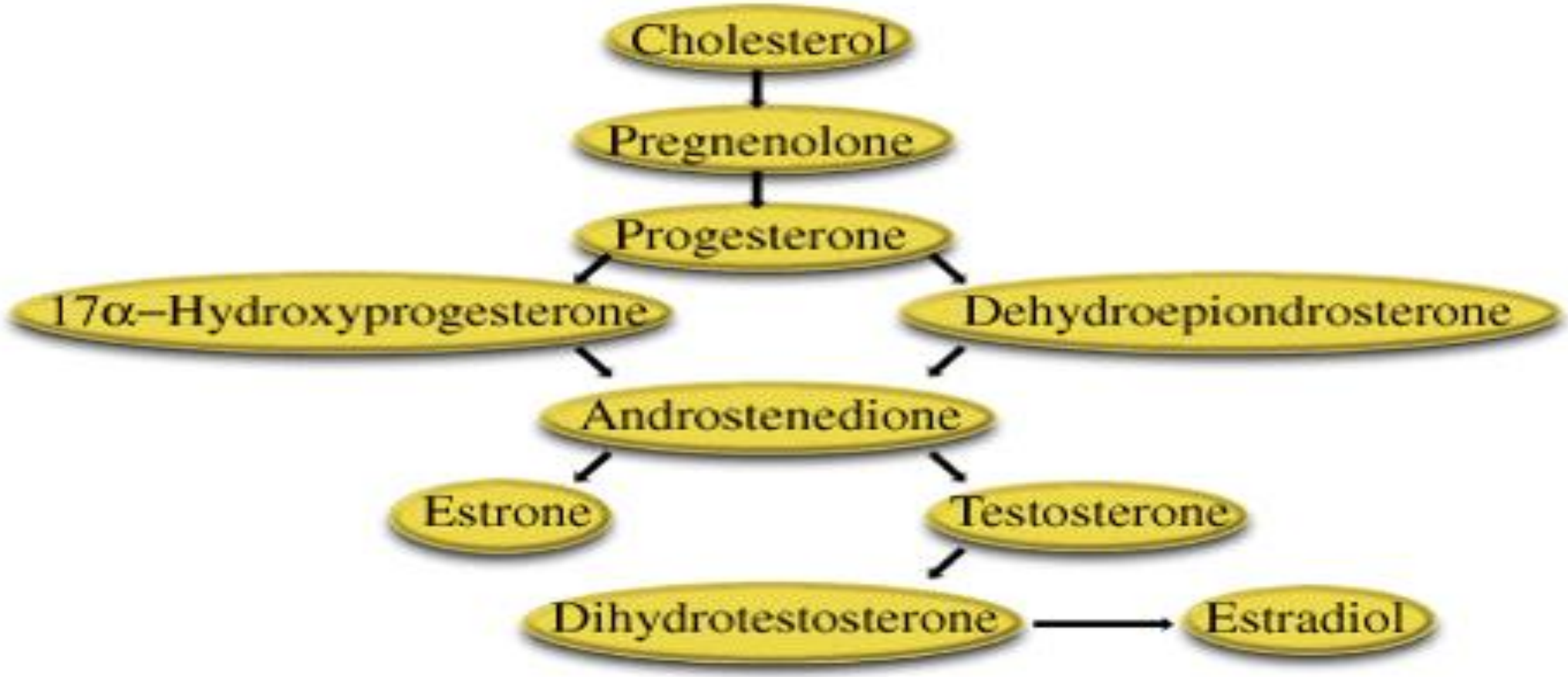
2:26 PM
10/14/2018

Anabolic Steroids Status in Sports

- Normal T:ET ratio 1.3:1
- Positive test result 6:1 or 4:1

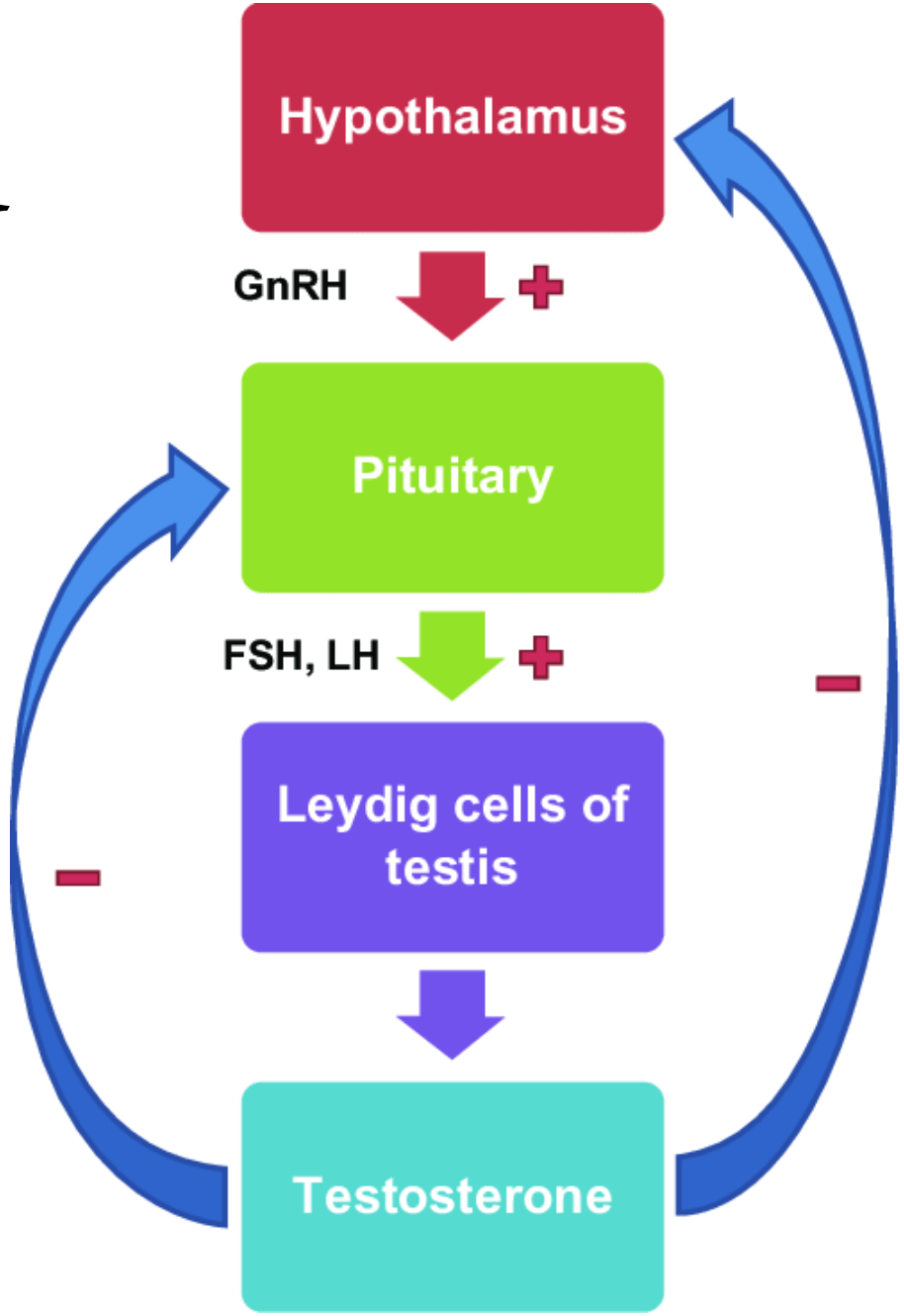
Steroid Chart

پیش سازهای تستوسترون



چرا پیش سازهای تستوسترون بهتر از خود تستوسترون هستند؟

- Only temporarily increases blood levels of testosterone, does not cause body to naturally produce testosterone.
- Has higher conversion rates to testosterone.
- Doesn’t convert into estrogen.
- Does not convert into DHT (cause of balding).



Negative Side Effects

- Balding
- Acne
- Enlarged prostate
- Reduced sperm count
- Increased aggression
- Kidney & Liver damage
- Disrupt the menstrual cycle
- Decrease levels of HDL cholesterol

TABLE 15.3 Possible Health Consequences of Anabolic Steroid Use *(Part 1)*

Category	Effects
Cardiovascular effects	Hypertension (high blood pressure)
	Increased blood clotting
	Increased red blood cells
	Decreased HDL cholesterol (the "good" kind of cholesterol)
Effects on the liver (particularly from oral steroid use)	Jaundice
	Peliosis hepatis (blood-filled cysts in the liver)
	Tumors
Effects on the skin and hair	Oily skin and scalp
	Severe acne
	Male pattern baldness
Growth effects	Growth stunting in adolescents due to premature epiphyseal closure

TABLE 15.3 Possible Health Consequences of Anabolic Steroid Use *(Part 2)*

Category	Effects
Behavioral effects	Increased libido (sex drive)
	Increased irritability and aggressiveness
	Dependence
Specific effects on men	Testicular shrinkage
	Reduced sperm counts and possible infertility
	Prostate enlargement
	Gynecomastia (breast development)
Specific effects on women	Menstrual abnormalities
	Deepening of the voice
	Excessive hair growth, especially on the face
	Enlargement of the clitoris
	Decreased breast size

Anabolic Steroids
Adverse Effects

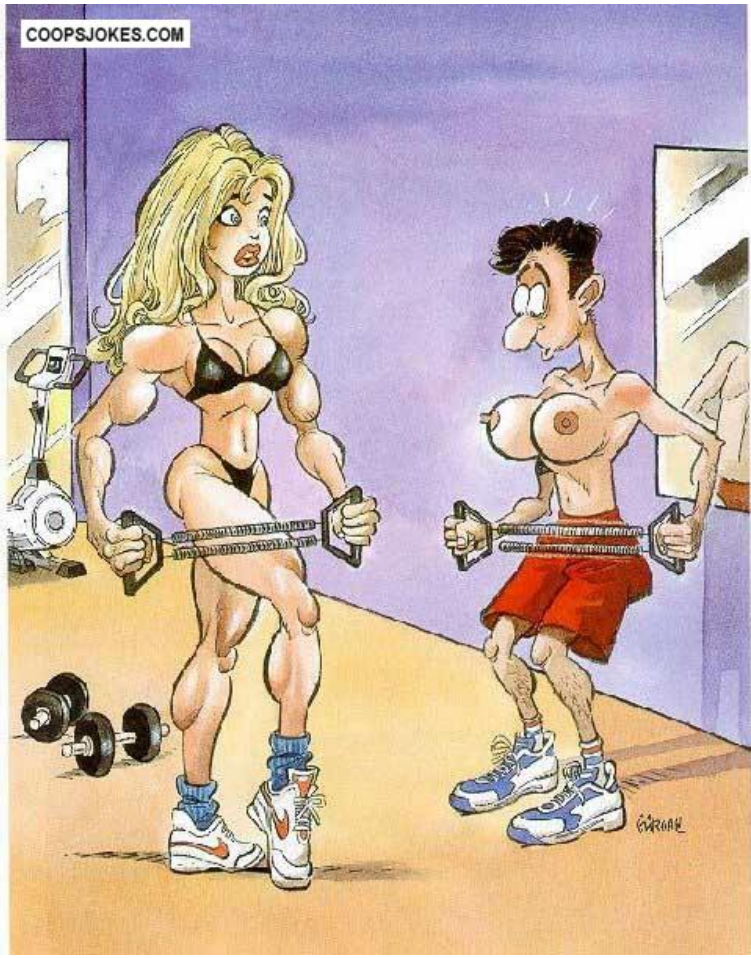
- Accelerate the rate of premature baldness (male and female)
- Acne – stimulates the sebaceous glands
- Liver damage (cancer) – increased demand on liver as oral steroids are changed (increase bioavailability and stability)

Anabolic Steroids Adverse Effects

- Tendon rupture has been linked to AS
- Stiffer and less elastic tendon
- No consistent AS –induced ultrastructural or biochemical alterations
- Probably tendon does not adapt as fast

Anabolic Steroids
Gender Specific Effects

- Gynecomastia – development of breast tissue in males
- Conversion of testosterone to estrogen by an aromatase enzyme



Anabolic Steroids
Female-Specific Effects

- Increase in body hair
- Male-pattern baldness
- Deepening of voice (permanent)
- Enlarged clitoris (permanent)
- Temporary decrease in menstrual cycle
- Affect fetal development during pregnancy

Anabolic Steroids
Behavioral Effects

- Controversial
- Mood swings
- Aggression (roid rage)
- Mania
- Depression
- Withdrawal
- Dependence

Steroid design issues

testosterone can be converted to estradiol by aromatase (aromatisation)

normal process, mediating testosterone effects on CNS

this has *feminising* effects - so is also to be avoided

Anabolic Steroids
Adverse Effects

- Risk of mortality among chronic AS users repoted to be 4.6 times higher than non-AS users
- Weekly doses of 600 mg ot testosterone or its equivalent for cycles lasting less than 12 weeks appear to cause few side effects during scientific studies
- Rule: bigger the dose, the bigger the muscle, the bigger the problem

Minimization of Side Effects
(during cycles and post cycle)

- Increase CV exercise to counter act effects on left ventricle
- Estrogen receptor modulators to reduce effect of aromatization of steroid hormones (tamoxifen) reduce gynecomastia

Post Cycle Therapy

- “Clomiphene or tamoxifen (Primary PCT drug)
  1. Anastrozole – aromatase inhibitor
  2. HCG – restore hormonal balance

  - Human chorionic gonadotropin (**HCG**) is a hormone produced by the placenta after implantation.

Steroid design issues

- testosterone can be converted in some tissues to dihydrotestosterone (DHT) by 5α-reductase. This has *androgenic* effects - so is to be avoided as want the anabolic effects (doesn't happen in skeletal muscle).

- Finasteride (Propecia) – reduces the conversion of testosterone to DHT (high rate of alopecia)

- این دارو در مواردی که استروئید به یک مشتق آندروژنیک تبدیل نمی شود بی فایده است.

Side effects: behavioural

addictive? *to some extent -- users show:*

withdrawal symptoms -- fatigue, depression, insomnia, restlessness, anorexia, decreased libido, dissatisfaction with body image, desire for more steroids(!)

but no big studies so don't know how common this is...

symptoms could be rare... or just unreported