Overall Organization of the Lecture Series

- Structure, Nomenclature, Conformation, Configuration
- Androgens
- Estrogens and Progestins
Examples of Steroid-based Drugs in Use Today

Male Sex Hormone

Female Sex Hormone

Anti-inflammatory Agent

Congested Heart Symptoms
Functional Classification of Steroids

- **Anabolic Steroids**
  - Interact with androgen receptor; enhance muscle mass/athlete’s performance; male sex hormones

- **Glucocorticoids**
  - Regulate metabolism and immune function; anti-inflammatory activity

- **Mineralocorticoids**
  - Maintain blood volume and renal excretion

- **Progestins**
  - Development of female sex organs and characteristics

- **Phytosteroids**
  - Plant steroids

- **Ergosteroids**
  - Steroids of the fungi; vitamin D related
Structures of Steroids

Structure and Nomenclature of the Steroid Nucleus
Configurational Isomers of Steroids

Fusion points between rings

trans- configuration

cis- configuration
Configurational Isomers of Steroids

Fusion points between rings

3 fusion points $\rightarrow 2^3$ isomers $= 8$
Configurational Isomers of Steroids

Three dimensional structure of three most common isomers

- trans-trans-trans
- cis-trans-trans
- cis-trans-cis

- trans-trans-trans
- cis-trans-cis
- cis-trans-cis
Nomenclature of Steroids

α- and β- configuration and numbering
Nomenclature of Steroids

α- and β- configuration and numbering
Nomenclature of Steroids

Number of Nuclear Positions and Steroid Classification

- C-27 skeleton … Cholestanes
- C-24 skeleton … Cholanes
- C-21 skeleton … Pregnanes
- C-19 skeleton … Androstanes
- C-18 skeleton … Estranes
Nomenclature of Steroids

Usage of ‘Nor’ terminology

- C-27 skeleton … Cholestanes
- CH3
  - CH3
  - C-19 skeleton … Androstanes
- CH3
  - CH3
- 18-Nor C-27 skeleton … 18-nor cholestan
- CH3
  - CH3
- 19-Nor C-19 skeleton … 19-nor androstan
- CH3
  - CH3
All steroid hormones are derived from cholesterol and differ only in the ring structure and side chains attached to it.

All steroid hormones are lipid soluble.
Major Pathways in Steroid Biosynthesis

Cholesterol → Methyl group

Pregnenolone → 17-hydroxy pregnenolone → Dehydroepiandrosterone
CYP17

Progesterone → 17-hydroxy progesterone → Androstenedione
CYP21A2

Deoxycorticosterone → 11-deoxycorticisol → Estrone
CYP11B1

Corticosterone → Cortisol → Estradiol
CYP11B2

Androstenedione → Testosterone
CYP19

17βHSD

Color codes:
- Orange: Major progestagen
- Green: Major mineralocorticoid
- Yellow: Major glucocorticoid (species variation)
- Pink: Major gonadal estrogens
- Blue: Major gonadal androgen
STEROID HORMONE SYNTHESIS

- All steroid hormones are derived from cholesterol.
- A series of enzymatic steps in the mitochondria and ER of steroidogenic tissues convert cholesterol into all of the other steroid hormones and intermediates.
- The rate-limiting step in this process is the transport of free cholesterol from the cytoplasm into mitochondria. **This step is carried out by the Steroidogenic Acute Regulatory Protein (StAR)**
Skeletal structures

Progesterone

Cortisone
Skeletal structures

Prednisone

Prednisolone
Skeletal structures

Betamethasone

Dexamethasone