PIPADOR REVISION

MRCOG Part 1 Revision Notes

Steroid Hormones: Structure

BIOCHEMISTRY • LECTURE 228

VISUAL EXAMINATION REVISION NOTES

2026 Edition

228

MRCOG PART 1 REVISION NOTES | BIOCHEMISTRY

Steroid Hormones: Structure

The steroid nucleus, classes by carbon number, structure–function relationships and synthetic steroids

4 rings	C21	C19	C18
Cyclopentano-perhydrophenanthrene	Progestogens & corticosteroids	Androgens	Oestrogens (aromatic A-ring)

■ **KEY FACTS: Learning objectives**

- Describe the steroid nucleus and its numbering, and classify steroids by carbon number.
- Relate structural features to function, receptor specificity, transport and metabolism.
- Describe how synthetic steroids are modified for therapeutic use.

228.1 The steroid nucleus

All steroids share the **cyclopentanoperhydrophenanthrene** nucleus — three six-membered rings (**A, B, C**) and one five-membered ring (**D**), 17 carbons, numbered from ring A. Steroids are **lipophilic**, derived from **cholesterol** (C27), not stored (synthesised on demand), transported **protein-bound** and act mainly via **nuclear receptors** (Lecture 207).

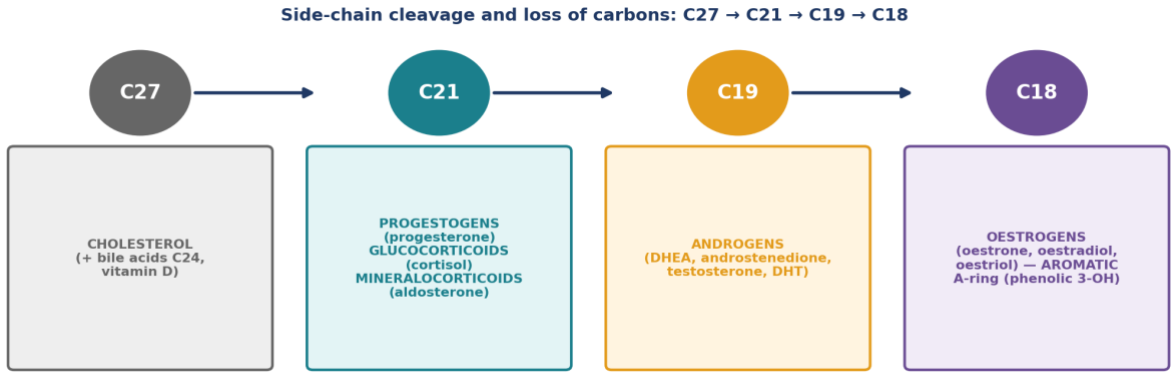


Figure 228.1 — Steroid classes by carbon number

Class	Carbons	Key structural features	Examples
Cholesterol	C27	3β-OH, Δ^5 double bond, 8-carbon side chain at C17	Membrane lipid; precursor of all steroids
Progestogens	C21	Δ^4-3-keto (A-ring), 2-carbon side chain at C17 (20-keto)	Progesterone, 17-OH-progesterone
Glucocorticoids	C21	11β-OH, 17α-OH, 21-OH	Cortisol (cortisone = 11-keto, inactive)
Mineralocorticoids	C21	18-aldehyde, 11β-OH, 21-OH	Aldosterone, deoxycorticosterone
Androgens	C19	17-keto (androstenedione) or 17β-OH (testosterone); 5α-reduced A-ring (DHT)	DHEA, androstenedione, testosterone, DHT
Oestrogens	C18	Aromatic (phenolic) A-ring, no C19 methyl; 17β-OH (E2), 17-keto (E1), 16α-OH (E3)	Oestrone, oestradiol, oestriol, estetrol
Secosteroids	—	B-ring opened (UVB)	Vitamin D_3, calcitriol
Bile acids	C24	Hydroxylated, carboxylic side chain	Cholic, chenodeoxycholic acids

228.2 Structure and function

- **Lipophilicity** → diffusion across membranes and the placenta; poor water solubility → **binding proteins** (SHBG: androgens > oestradiol; CBG: cortisol, progesterone; albumin) and **conjugation** (sulphate, glucuronide) for excretion.
- **Small changes alter receptor specificity**: 11β-OH (cortisol) → glucocorticoid; 18-aldehyde (aldosterone) → mineralocorticoid selectivity; aromatic A-ring → oestrogen receptor binding.
- **Enzymatic 'pre-receptor' regulation**: 11β-HSD2 oxidises cortisol → cortisone (kidney, **placenta**); 5α-reductase T → DHT; aromatase androgens → oestrogens; 17β-HSD interconverts active/less active forms.
- **Sulphated** steroids (DHEAS, oestrone sulphate) are water-soluble circulating reservoirs.

228.3 Synthetic steroids

Modification	Effect	Examples
17α-ethinyl group	Blocks hepatic 17β-oxidation → orally active, potent, strong hepatic effects (SHBG, clotting factors)	Ethinylestradiol; norethisterone, levonorgestrel
19-nor (remove C19 methyl)	Progestogenic with some androgenicity	Norethisterone, levonorgestrel, desogestrel
9α-fluoro, 16-methyl	↑ Glucocorticoid potency, ↓ mineralocorticoid, resistant to 11β-HSD2 → cross placenta	Betamethasone, dexamethasone (fetal lung maturation)
Δ^1 double bond	↑ Glucocorticoid potency; inactivated by placental 11β-HSD2	Prednisolone (preferred for maternal disease — little fetal exposure)
Esterification	Depot/prolonged action	Medroxyprogesterone acetate (DMPA), testosterone undecanoate
Non-steroidal mimics	Bind ER without steroid nucleus	Tamoxifen, clomifene, diethylstilbestrol (DES — vaginal clear cell carcinoma, uterine anomalies in exposed daughters)

228.4 Must-know summary

■ **EXAM TIP**

- Steroid nucleus: rings A–D, 17 carbons; all from cholesterol (C27).
- **C21** progestogens/corticoids; **C19** androgens; **C18** oestrogens (aromatic A-ring).
- Bound to SHBG/CBG/albumin; conjugated for excretion; 11β-HSD2, 5α-reductase and aromatase modify activity locally.
- Ethinyl group → oral potency; fluorinated steroids (betamethasone/dexamethasone) cross placenta; prednisolone does not (much).

■ **MNEMONIC / MEMORY AID**

'27 → 21 → 19 → 18': Cholesterol → Progesterone/Cortisol/Aldosterone → Androgens → Oestrogens.