PIPADOR REVISION

MRCOG Part 1 Revision Notes

Tyrosine-Derived Hormones

BIOCHEMISTRY • LECTURE 230

VISUAL EXAMINATION REVISION NOTES

2026 Edition

230

MRCOG PART 1 REVISION NOTES | BIOCHEMISTRY

Tyrosine-Derived Hormones

Catecholamines and thyroid hormones — synthesis, transport, receptors, metabolism and clinical relevance

Tyrosine	Membrane	Nuclear	$T_3 \approx 4\times$
Precursor of catecholamines & T_3/T_4	Catecholamine receptors (GPCR)	Thyroid hormone receptors	More potent than T_4

■ KEY FACTS: Learning objectives

- Describe the synthesis, storage, transport and metabolism of catecholamines and thyroid hormones from tyrosine.
- Contrast the receptor mechanisms of the two groups.
- Relate to clinical disorders and pregnancy (PKU, phaeochromocytoma, thyroid disease).

230.1 Tyrosine and its derivatives

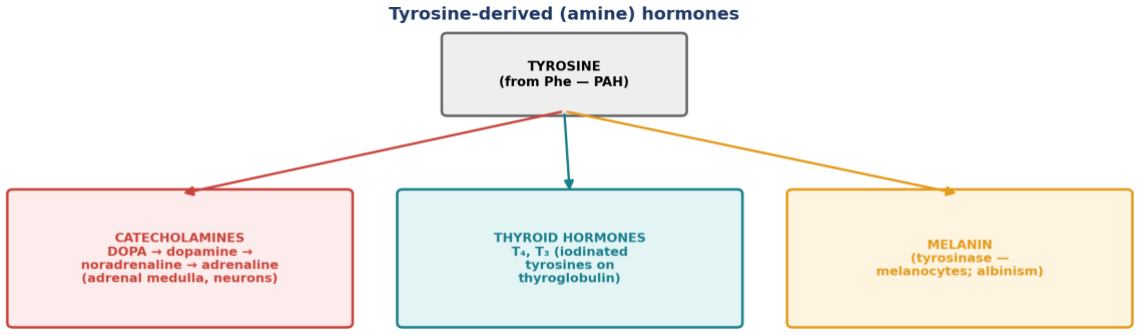


Figure 230.1 — Tyrosine-derived hormones

Tyrosine comes from the diet or from **phenylalanine** (phenylalanine hydroxylase, BH4) — in **PKU** tyrosine becomes essential (Lecture 223). Amine hormones split into two very different groups: water-soluble **catecholamines** (membrane receptors) and lipophilic **thyroid hormones** (nuclear receptors) — they behave like peptides and steroids respectively.

230.2 Catecholamines

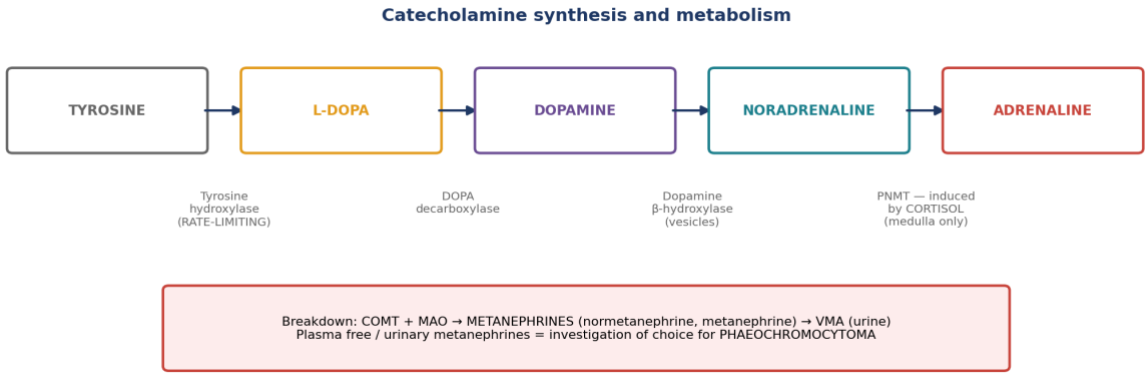


Figure 230.2 — Catecholamine synthesis and metabolism

Feature	Details
Synthesis	Tyrosine → DOPA (tyrosine hydroxylase — rate-limiting) → dopamine → noradrenaline (in vesicles) → adrenaline (PNMT — cortisol-induced, adrenal medulla)
Storage / release	Chromaffin granules; Ca^{2+}-triggered exocytosis (ACh from preganglionic sympathetic nerves)
Transport	Free in plasma; half-life ≈ 1–2 minutes
Receptors	GPCRs: α_1 (Gq), α_2 (Gi), $\beta_1/\beta_2/\beta_3$ (Gs), D_1 (Gs)/D_2 (Gi)
Inactivation	Reuptake (uptake-1; cocaine, tricyclics block), MAO and COMT → metanephrines, VMA
Clinical	Phaeochromocytoma (plasma/urine metanephrines; α before β), dopamine D_2 inhibition of prolactin, β_2 tocolysis (Lecture 177)

230.3 Thyroid hormones

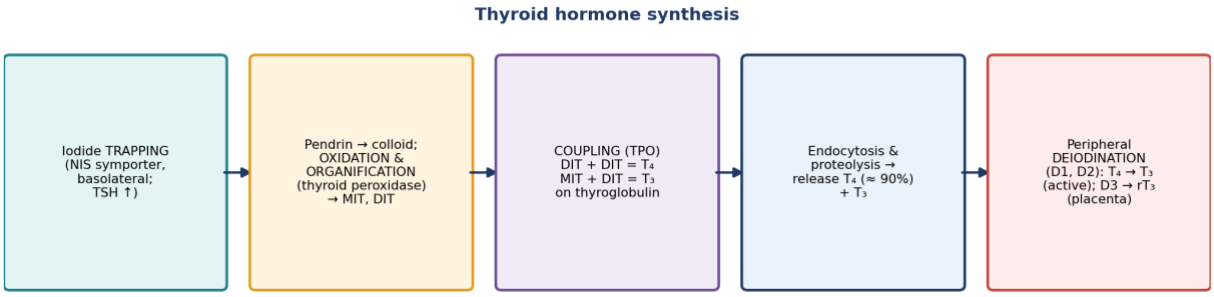


Figure 230.3 — Thyroid hormone synthesis

Feature	Details
Synthesis	Iodide trapping (NIS) → thyroid peroxidase organification of tyrosines on thyroglobulin → MIT/DIT → coupling → T_4 (and T_3) stored in colloid
Release	TSH → endocytosis and proteolysis of thyroglobulin; T_4 : T_3 ≈ 90 : 10
Transport	TBG (≈ 70%), transthyretin, albumin — free T_4 ≈ 0.03%; TBG doubles in pregnancy/COC
Activation	Deiodinases: D1/D2 T_4 → T_3 (active); D3 (placenta) → reverse T_3 (inactive)
Receptor	Nuclear TRα/TRβ with RXR on thyroid response elements → gene transcription (BMR, β-adrenergic sensitivity, brain development)
Drugs	Carbimazole/PTU inhibit TPO (PTU also ↓ D1); iodide (Wolff–Chaikoff); amiodarone (iodine load, ↓ D1)

	Catecholamines	Thyroid hormones
Solubility	Hydrophilic	Lipophilic
Storage	Vesicles (ready-made)	As thyroglobulin (weeks' supply)
Plasma binding	Little	> 99% bound
Half-life	Minutes	T_4 ≈ 7 days, T_3 ≈ 1 day
Receptor	Membrane GPCR	Nuclear
Placental transfer	Metabolised by placental MAO/COMT	Limited T_4 transfer (vital early); D3 inactivates excess

230.4 Must-know summary

■ EXAM TIP

- Tyrosine → catecholamines (tyrosine hydroxylase rate-limiting; PNMT needs cortisol), **thyroid hormones**, melanin.
- Catecholamines behave like peptides (GPCRs, minutes); thyroid hormones like steroids (nuclear receptors, bound, long half-life).
- T_4 → T_3 by D1/D2; placental D3 inactivates; TBG ↑ in pregnancy.
- Metanephrines diagnose phaeo; TPO is the target of antithyroid drugs.

■ MNEMONIC / MEMORY AID

'Tyrosine makes Three Ts': caTecholamines, Thyroid hormones, and (melanin) Tanning.