PIPADOR REVISION

MRCOG Part 1 Revision Notes

Thyroid Hormones (T_3 and T_4)

ENDOCRINOLOGY • LECTURE 179

VISUAL EXAMINATION REVISION NOTES

2026 Edition

179

MRCOG PART 1 REVISION NOTES | ENDOCRINOLOGY

Thyroid Hormones (T_3 and T_4)

Synthesis and action, pregnancy changes, fetal thyroid and transfer, and thyroid disease in pregnancy

≈ 90 : 10	≈ 99.97%	↑ 25–30%	10–12 wk
T_4 : T_3 secreted (T_3 more active)	T_4 protein-bound (TBG mainly)	Levothyroxine dose once pregnant	Fetal thyroid begins to function

■ KEY FACTS: Learning objectives

- Describe thyroid hormone synthesis, transport, metabolism, receptor action and regulation.
- Describe thyroid physiology in pregnancy, including the effects of hCG, TBG, iodine and deiodinases.
- Describe fetal thyroid development and maternal–fetal transfer.
- Describe hypothyroidism, hyperthyroidism, gestational thyrotoxicosis and postpartum thyroiditis in pregnancy.

179.1 Synthesis, transport and action

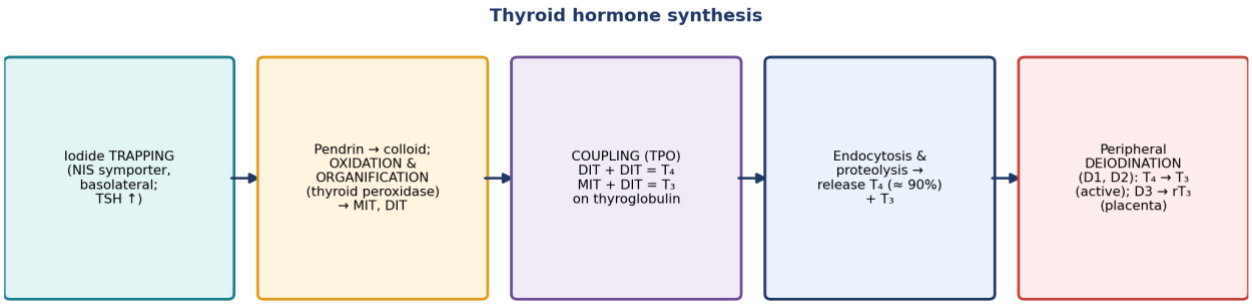


Figure 179.1 — Thyroid hormone synthesis

- **Transport**: T_4 bound to **TBG** (≈ 70%), transthyretin and albumin; free T_4 ≈ 0.03%. T_3 is less bound and more potent.
- **Deiodinases**: D1 (liver, kidney) and **D2** (brain, pituitary, brown fat) convert T_4 → **T_3**; **D3** (placenta, brain) inactivates T_4 → reverse T_3 — protects the fetus from excess maternal hormone.
- **Action**: T_3 binds **nuclear thyroid hormone receptors** (TRα, TRβ) → ↑ BMR, O_2 consumption, thermogenesis, β-adrenergic sensitivity, cardiac output; essential for **brain development and myelination** and bone growth.
- **Regulation**: TRH → TSH → thyroid; T_3/T_4 negative feedback (pituitary D2). Wolff–Chaikoff effect (high iodide transiently ↓ synthesis).

179.2 The thyroid in pregnancy

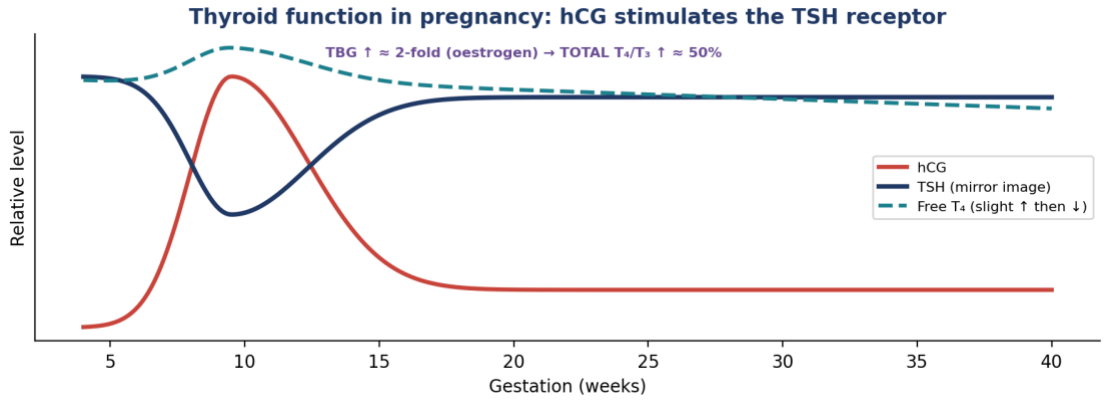


Figure 179.2 — hCG, TSH and free T_4 in pregnancy

Change	Mechanism / consequence
hCG stimulates TSH receptor	Peak hCG at 8–12 wk → slight ↑ free T_4 and ↓ TSH (may be suppressed in ≈ 15%); use trimester-specific ranges (if unavailable, upper TSH limit ≈ 4.0 mU/L, ATA)
TBG ↑ ≈ 2-fold	Oestrogen ↑ hepatic synthesis and sialylation → total T_4/T_3 ↑ ≈ 50%; measure free hormones (immunoassays less reliable late)
↑ Iodine requirement	↑ T_4 production (≈ 50%), ↑ renal iodide clearance (↑ GFR), fetal transfer → WHO 250 µg/day (Lecture 141)
Placental D3	Inactivates maternal T_4/T_3 — ↑ maternal T_4 demand
Thyroid size	Slight enlargement (more in iodine deficiency)
Immune	Autoimmune thyroid disease often improves in pregnancy (Th2 shift) and flares postpartum

179.3 Fetal thyroid and transfer

Topic	Key points
Fetal thyroid	Iodine uptake and T_4 synthesis from ≈ 10–12 weeks; HPT axis matures 18–20 weeks; until then (and partly to term) the fetus depends on maternal T_4 for brain development
Crosses placenta	T_4 (limited but vital), iodide, TRH, TSH-receptor antibodies (TRAb), antithyroid drugs (carbimazole, PTU), amiodarone, β-blockers
Does NOT cross	TSH (negligible)
Birth	TSH surge within minutes (cold) → ↑ T_4/T_3 → thermogenesis; screening by newborn bloodspot (day 5, TSH) for congenital hypothyroidism (≈ 1 in 2000–3000)

179.4 Thyroid disease in pregnancy

Condition	Key points
Hypothyroidism (Hashimoto's, post-ablation)	↑ Miscarriage, pre-eclampsia, preterm birth, impaired child neurodevelopment (untreated). Increase levothyroxine by ≈ 25–30% (e.g. 2 extra doses/week) as soon as pregnancy confirmed; aim TSH < 2.5 mU/L; check TFTs every 4–6 weeks; reduce to pre-pregnancy dose after birth
Subclinical hypothyroidism	Treat if TSH above trimester range, especially with TPO antibodies (benefit for outcomes uncertain)
Graves' disease	May improve mid-pregnancy, flare postpartum. PTU in 1st trimester (carbimazole embryopathy: aplasia cutis, choanal/oesophageal atresia), switch to carbimazole after (PTU hepatotoxicity); lowest dose keeping fT_4 upper-normal; TRAb at diagnosis/≈ 20 wk — high levels → fetal/neonatal thyrotoxicosis (fetal tachycardia, goitre, FGR) — even after ablation

Condition	Key points
Gestational transient thyrotoxicosis	hCG-mediated, with hyperemesis/molar pregnancy/twins; no goitre or TRAb; resolves by 14–18 weeks — supportive (no antithyroid drugs)
Thyroid storm	Infection/labour triggers; PTU, β-blocker, steroids, iodine (after PTU), supportive
Postpartum thyroiditis	5–10% (↑ with TPO antibodies, type 1 diabetes): hyperthyroid 1–4 months (painless, low uptake — β-blockers only) → hypothyroid 4–8 months (thyroxine if symptomatic); ≈ 20–50% later permanent hypothyroidism

179.5 Must-know summary

■ EXAM TIP

- Iodide trapping (NIS) → TPO organification/coupling → T_4 (90%) → peripheral **D1/D2 → T_3**; placenta **D3** inactivates.
- Pregnancy: **hCG ↓ TSH** (1st trimester); **TBG ↑ → total T_4 ↑**; measure free T_4 with trimester ranges.
- Fetal thyroid from 10–12 wk; **maternal T_4 essential** early; TRAb and antithyroid drugs cross, TSH does not.
- Hypothyroid: **↑ thyroxine 25–30% at confirmation**. Graves': **PTU 1st trimester → carbimazole**.
- Postpartum thyroiditis: hyper (1–4 mo) → hypo (4–8 mo).

■ MNEMONIC / MEMORY AID

Thyroid synthesis — 'TOCER': Trapping, Oxidation/organification, Coupling, Endocytosis, Release (+ peripheral deiodination). **'PTU for the First, Carbimazole for the Rest'**.