



PIPADOR REVISION

MRCOG Part 1 Revision Notes

The Hypothalamus and Pituitary

ANATOMY • LECTURE 36

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 36: The Hypothalamus and Pituitary

Anatomy • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

HYPOTHALAMUS

ANTERIOR PITUITARY

POSTERIOR PITUITARY

CLINICAL

FEEDBACK / TARGETS

LEARNING OBJECTIVES — tick off as you go

- ☐ Describe the position, boundaries and key nuclei of the hypothalamus.
- ☐ Describe the pituitary's relations, development and blood supply.
- ☐ Explain the portal system and the axonal route to the posterior lobe.
- ☐ Describe GnRH pulsatility, kisspeptin and ovarian feedback.
- ☐ Apply to Sheehan's syndrome, prolactinoma, hypothalamic amenorrhoea, Kallmann syndrome and ADH disorders.

1 The Hypothalamus

IN ONE LINE: Floor and lower side walls of the third ventricle, below the thalamus — the link between the nervous and endocrine systems.

- **Boundaries:** optic chiasm + lamina terminalis in front; mammillary bodies behind; hypothalamic sulcus above; tuber cinereum → infundibulum below.

Nucleus	Function	Output
Supraoptic	Mainly ADH (vasopressin)	Axons → posterior lobe
Paraventricular	Mainly oxytocin (+ some ADH, CRH, TRH)	Axons → posterior lobe; median eminence
Arcuate (infundibular)	GnRH neurones, KNDy neurones, dopamine	Median eminence → portal system
Preoptic	GnRH neurones; thermoregulation	Median eminence
Suprachiasmatic	Circadian master clock	Pineal (via sympathetics)
Ventromedial / lateral	Satiety / hunger	Behaviour
Mammillary	Memory (Papez circuit)	Anterior thalamus

2 The Pituitary: Position, Relations and Development

Hypothalamus and pituitary — sagittal schematic (anterior on the LEFT)

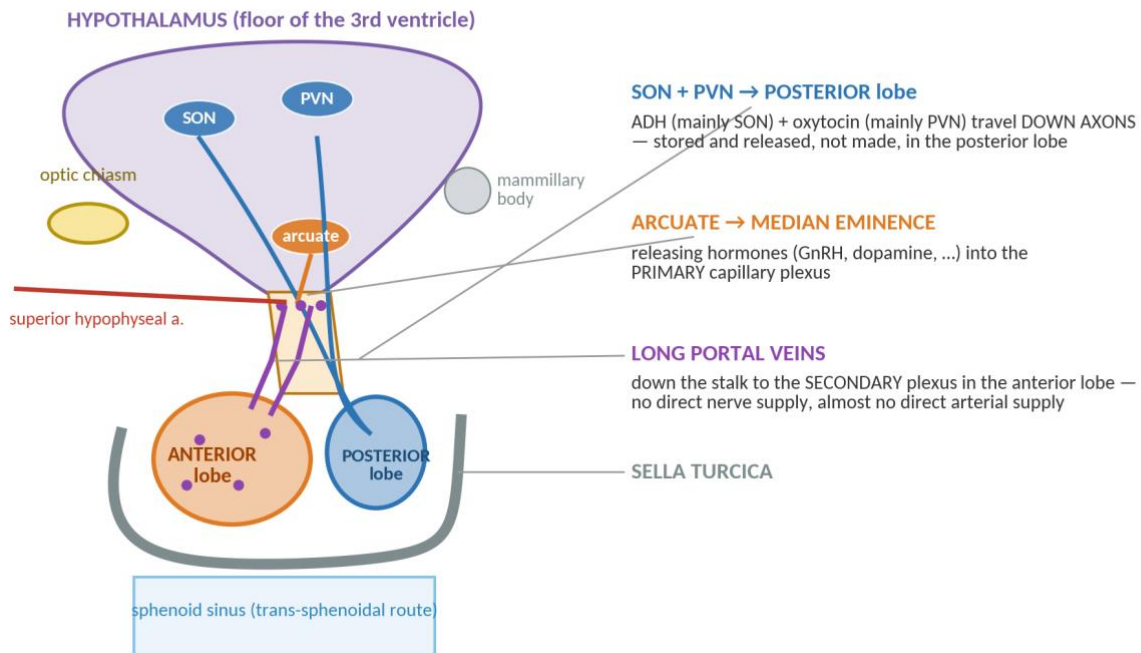
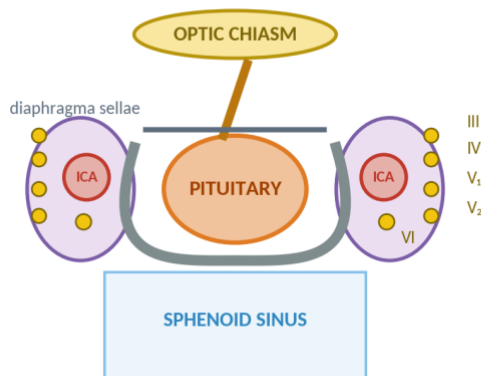


Figure 1. Two routes from hypothalamus to pituitary.

Pituitary relations — coronal schematic



- ABOVE: optic chiasm**
compression → BITEMPORAL HEMIANOPIA
- SIDES: cavernous sinuses**
ICA + VI inside; III, IV, V₁, V₂ in the lateral wall → ophthalmoplegia, facial numbness with lateral spread
- BELOW: sphenoid sinus**
the TRANS-SPHENOIDAL surgical route
- BEHIND: dorsum sellae**
basilar artery, pons

Figure 2. What surrounds the pituitary.

ADENOHYPOPHYSIS (anterior)

- **Oral ectoderm** — Rathke's pouch grows up from the stomodeum
- Pars distalis, pars tuberalis, pars intermedia (vestigial)
- Remnants → Rathke's cleft cysts

NEUROHYPOPHYSIS (posterior)

- **Neuroectoderm** — the infundibulum grows down from the diencephalon
- Pars nervosa, infundibular stalk, median eminence

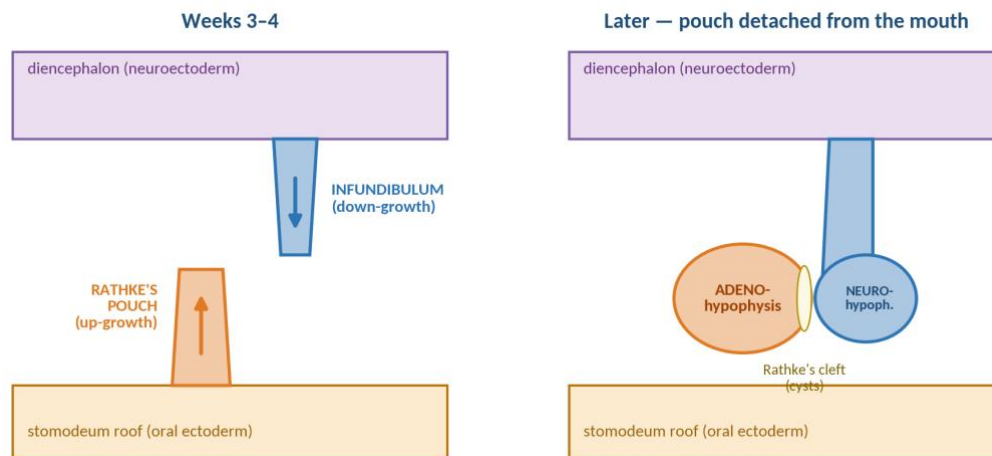
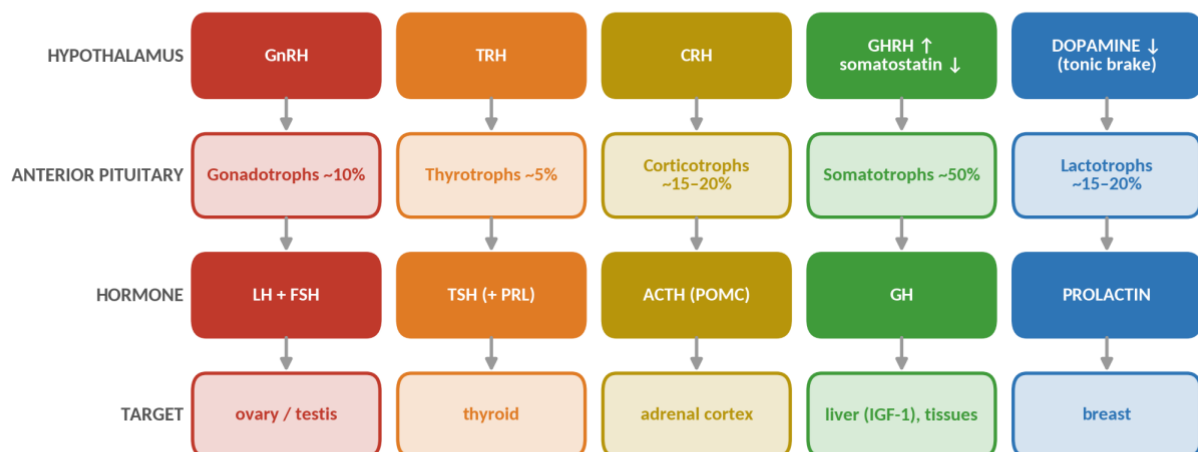


Figure 3. Two origins, one gland.

- Size $\sim 1 \times 1.5 \times 0.5$ cm, ~ 0.5 g, in the **sella turcica** under the **diaphragma sellae**. It enlarges markedly in pregnancy (lactotroph hyperplasia — often quoted as $\sim 135\%$, i.e. more than doubling by term).

3 Anterior Pituitary and the Portal System

Hypothalamus → anterior pituitary → target



Prolactin is the only one held DOWN by the hypothalamus (dopamine) — so a damaged stalk RAISES prolactin and lowers everything else.

Figure 4. Hypothalamic hormones and their pituitary targets.

Hormone	Reproductive role
FSH	Glycoprotein (shared α -subunit with LH, TSH, hCG) — granulosa aromatase + follicle growth; Sertoli cells / spermatogenesis
LH	Theca androgens (aromatase substrate), mid-cycle surge → ovulation, supports the corpus luteum; Leydig testosterone. β -subunit resembles hCG
Prolactin	Milk synthesis. Under tonic dopamine inhibition; high prolactin suppresses GnRH → amenorrhoea (lactational amenorrhoea, prolactinoma)

Blood supply	Detail
Superior hypophyseal aa. (ICA)	Median eminence + stalk → primary capillary plexus

Blood supply	Detail
Long portal veins	Down the stalk → secondary plexus in the anterior lobe — high local concentrations of releasing hormones (Harris)
Inferior hypophyseal aa. (cavernous ICA)	Posterior lobe — a true arterial supply; short portal vessels link posterior → anterior

EXAM HOOK

The **anterior lobe depends on portal venous blood** — it has no direct arterial supply to speak of. That, plus pregnancy enlargement, is why it **infarcts after massive PPH (Sheehan's)** while the posterior lobe usually survives.

4 Posterior Pituitary

OXYTOCIN

- 9 amino acids — differs from ADH at only two
- Mainly **PVN**; carried with **neurophysin**; half-life a few minutes
- Uterine contraction (receptors rise towards labour) and **milk let-down** (myoepithelial cells)
- Released by **Ferguson's reflex** (cervical stretch) and suckling — a positive-feedback loop

ADH (VASOPRESSIN)

- Mainly **SON**
- Triggered by ↑ osmolality (**OVLT** osmoreceptors) and ↓ volume (baroreceptors)
- **V2** (collecting duct) → aquaporin-2 → water reabsorption; **V1** → vasoconstriction
- Too little → **AVP deficiency** (cranial DI); too much → **SIADH**

5 The Hypothalamic–Pituitary–Ovarian Axis

GnRH: the pattern matters more than the amount

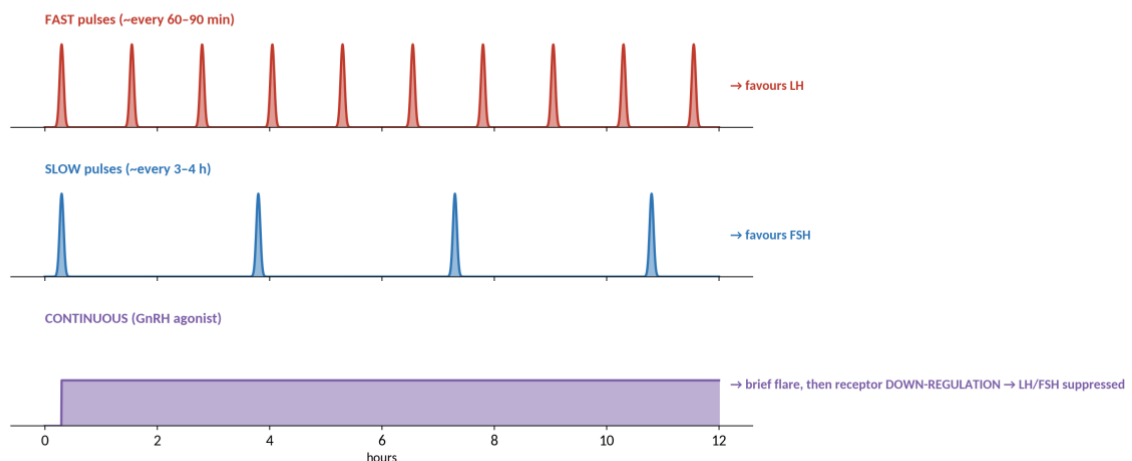


Figure 5. Pulse frequency decides the response.

The hypothalamic-pituitary-ovarian axis

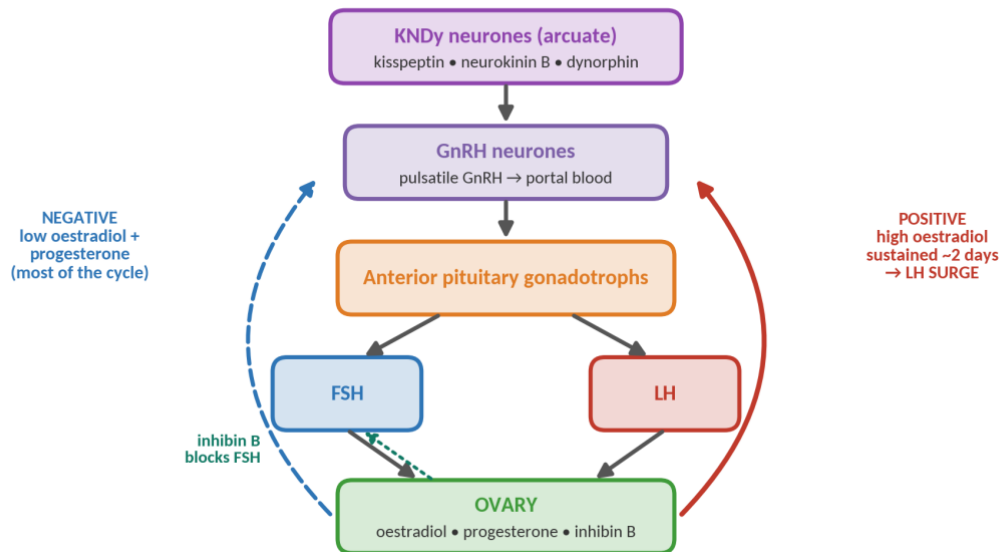


Figure 6. Kisspeptin drives GnRH; the ovary feeds back.

MNEMONIC / MEMORY HOOK

FAST = LH, SLOW = FSH, STEADY = STOP. Continuous GnRH (agonist) flares, then shuts the pituitary down.

- **Kisspeptin** (KISS1) from **KNDy neurones** in the arcuate nucleus is the main driver of GnRH pulses and the trigger for **puberty**; KISS1/KISS1R mutations → hypogonadotrophic hypogonadism.
- **Negative feedback** most of the cycle; **positive feedback** when oestradiol stays high (~200 pg/mL for ~2 days) → **LH surge**. **Inhibin B** selectively suppresses FSH.

6 Pregnancy and Lactation

- Prolactin rises through pregnancy but lactation is held back by **progesterone**; after delivery progesterone falls → **lactogenesis II** at ~day 2–4.
- **Suckling** (T4 afferents → hypothalamus) releases **prolactin** (milk synthesis) and **oxytocin** (let-down); prolactin suppresses GnRH → **lactational amenorrhoea** (reliable only with exclusive breastfeeding, amenorrhoea, < 6 months).

7 Clinical Correlations

SHEEHAN'S SYNDROME

- Anterior pituitary infarction after **massive PPH**
- **First sign: failure of lactation**; then amenorrhoea
- Later panhypopituitarism: fatigue, loss of body hair, hypothyroidism, **adrenal insufficiency**
- MRI: empty sella • replace **steroids FIRST**, then thyroxine, then sex steroids

PROLACTINOMA

- Commonest functioning adenoma
- Galactorrhoea, oligo-/amenorrhoea, infertility
- **Micro < 10 mm** (young women) vs macro (mass effect: bitemporal hemianopia, headache)
- **Cabergoline** (or bromocriptine) first-line; surgery if resistant

HYPOTHALAMIC AMENORRHOEA + KALLMANN

- Stress, weight loss, exercise → loss of GnRH pulses → **low LH, FSH, oestradiol**
- **Kallmann**: GnRH neurones fail to migrate from the olfactory placode → hypogonadotrophic hypogonadism + **anosmia**
- Fertility: **pulsatile GnRH** or gonadotrophins

ADENOMAS, APOPLEXY, ADH DISORDERS

- Non-functioning (mass effect), GH (acromegaly), ACTH (Cushing's disease), TSH (rare)
- **Apoplexy**: sudden headache, visual loss, ophthalmoplegia → **urgent steroids**
- **AVP deficiency** (cranial DI) responds to desmopressin; **AVP resistance** (nephrogenic) does not
- **SIADH**: euvolaemic hyponatraemia, concentrated urine — fluid restriction

★ PEARL

In pregnancy the anterior lobe **enlarges a lot**, yet it still relies on **portal venous blood**. When blood pressure collapses in PPH it infarcts — **Sheehan's**.

The earliest clue is **failure to lactate**; the diagnosis can be missed for years if later amenorrhoea, fatigue and weight loss are not linked back.

8 MRCOG Exam Pearls — Last-Minute Page**Numbers to know**

~0.5 g Pituitary weight	~50% Somatotrophs	9 Amino acids in oxytocin / ADH	60–90 min Fast GnRH pulses → LH
3–4 h Slow pulses → FSH	~2 days High oestradiol → LH surge	< 10 mm Microadenoma	day 2–4 Lactogenesis II

HIGH-YIELD CHECKLIST

- ☐ SON → ADH, PVN → oxytocin (axons to the posterior lobe); arcuate → GnRH, dopamine, KNDy.
- ☐ Anterior lobe from Rathke's pouch (oral ectoderm); posterior from the diencephalon (neuroectoderm).
- ☐ Relations: chiasm above, cavernous sinuses at the sides, sphenoid sinus below.
- ☐ Cavernous sinus: ICA + VI inside; III, IV, V₁, V₂ in the wall.
- ☐ Anterior lobe fed by long portal veins; posterior lobe by inferior hypophyseal arteries.
- ☐ Prolactin is under tonic dopamine inhibition — stalk damage raises it.
- ☐ Fast pulses → LH, slow → FSH, continuous → suppression.
- ☐ Kisspeptin/KNDy drive GnRH; high sustained oestradiol → LH surge; inhibin B → ↓ FSH.
- ☐ Sheehan's: failed lactation first; give steroids before thyroxine.
- ☐ Prolactinoma: cabergoline first; macroadenoma → bitemporal hemianopia.
- ☐ Kallmann: hypogonadotrophic hypogonadism + anosmia.

Quick-fire self-test — cover the right-hand column

Question	Answer
Which nucleus mainly makes oxytocin?	Paraventricular
Embryological origin of the anterior pituitary?	Rathke's pouch (oral ectoderm)

Question	Answer
What lies directly above the pituitary?	Optic chiasm
Which cranial nerve lies free inside the cavernous sinus?	Abducens (VI)
How do releasing hormones reach the anterior lobe?	Hypophyseal portal veins
Which pituitary hormone rises after stalk section?	Prolactin
GnRH pulse pattern that favours FSH?	Slow pulses
Main upstream driver of GnRH neurones?	Kisspeptin (KNDy neurones)
First clinical sign of Sheehan's syndrome?	Failure of lactation
First-line treatment for prolactinoma?	Cabergoline
Kallmann syndrome = hypogonadotrophic hypogonadism plus...?	Anosmia

9 References

- Standring S, editor. Gray's Anatomy. 42nd ed. 2020.
- Cunningham FG et al. Williams Obstetrics. 26th ed. 2022.
- Melmed S et al. Diagnosis and treatment of hyperprolactinemia: Endocrine Society guideline. 2011.
- Arima H et al. Changing the name of diabetes insipidus: a position statement. 2022.