ENDOCRINOLOGY — EMBRYOLOGY

• Thyroid: Endoderm origin (foramen cecum). Migration defects → thyroglossal duct cyst (midline), lingual thyroid.
• Parathyroids: 3rd (inferior) & 4th (superior) pharyngeal pouches. DiGeorge → hypocalcemia, T-cell deficiency.
• Adrenal gland:
  – Cortex: mesoderm → glomerulosa, fasciculata, reticularis.
  – Medulla: neural crest → catecholamines.
• Pancreas: Endoderm. Ventral + dorsal buds fuse. Annular pancreas → duodenal narrowing.

ENDOCRINOLOGY — PHYSIOLOGY

• Hormone classes:
  – Peptide: insulin, PTH → membrane receptors → second messengers.
  – Steroid: cortisol, aldosterone → intracellular receptors → gene transcription.
  – Amine: T3/T4 (nuclear), catecholamines (membrane).
• Receptor pathways:
  – cAMP: ACTH, TSH, FSH, LH, PTH, glucagon.
  – IP3: GnRH, TRH, ADH (V1).
  – Tyrosine kinase: insulin, IGF-1.
• Key physiology:
  – Aldosterone: ↑ Na^+ reabsorption; ↑ K^+ & H^+ secretion in collecting duct.
  – Cortisol: ↑ glucose, ↑ BP, ↓ immune response.
  – Thyroid: T3 most active; increases metabolic rate.

ENDOCRINOLOGY — PHARMACOLOGY (with site of action + side effects)

• Thyroid drugs:
  – Levothyroxine: T4 replacement; acts systemically. Side effects: hyperthyroid symptoms.
  – Methimazole/PTU: inhibit thyroid peroxidase (follicular cell). PTU also blocks T4→T3 peripherally.
    Side effects: agranulocytosis, hepatotoxicity (more with PTU).
• Adrenal drugs:
  – Glucocorticoids (prednisone, hydrocortisone): act intracellularly; ↓ inflammation.
    Side effects: hyperglycemia, osteoporosis, adrenal suppression, weight gain.
  – Fludrocortisone: mineralocorticoid acting in collecting duct. Side effects: hypertension, edema, hypokalemia.
• Diabetes medications:
  – Metformin: ↓ hepatic gluconeogenesis. Side effects: lactic acidosis, GI upset.
  – Sulfonylureas: block pancreatic K^+ channels → insulin release. Side effects: hypoglycemia, weight gain.
  – GLP-1 agonists: ↑ insulin, slow gastric emptying. Side effects: nausea, weight loss.
  – Insulin: acts on skeletal muscle/fat via GLUT-4 insertion. Side effects: hypoglycemia.

ENDOCRINOLOGY — PATHOLOGY

- Hypothyroidism:
  - Causes: Hashimoto (anti-TPO), iodine deficiency.
  - Labs: ↑ TSH, ↓ T4.
  - Features: weight gain, cold intolerance, bradycardia.
- Hyperthyroidism:
  - Causes: Graves (TSH receptor antibodies).
  - Labs: ↓ TSH, ↑ T3/T4.
  - Features: heat intolerance, tremor, exophthalmos.
- Adrenal diseases:
  - Addison: ↓ cortisol + aldosterone → hyperpigmentation, hypotension, hyperkalemia.
  - Cushing: ↑ cortisol → truncal obesity, striae, hypertension.
- Diabetes:
  - Type 1: autoimmune β-cell loss, absolute insulin deficiency.
  - Type 2: insulin resistance → hyperglycemia.