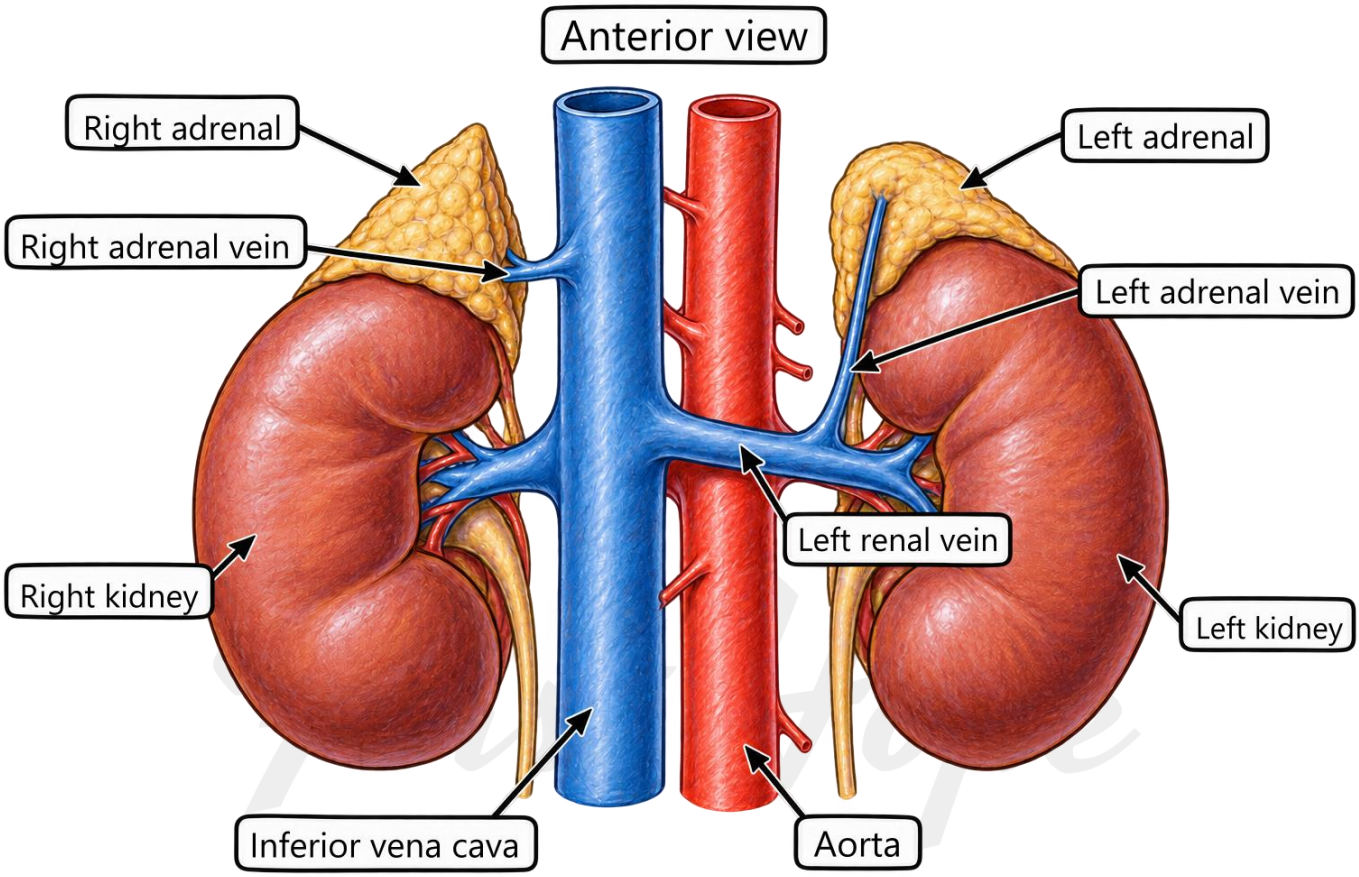
General Surgery - Topic 23 - Adrenal glands

Adrenal Gland Disorders and Tumours

- The adrenal glands lie in the retroperitoneum near the upper medial poles of the kidneys.

Applied Anatomy and Hormone Production



Anterior adrenal anatomy shows the short right adrenal vein entering the vena cava and the left vein joining the left renal vein

Position and Vessels

Position and Neighbouring Structures

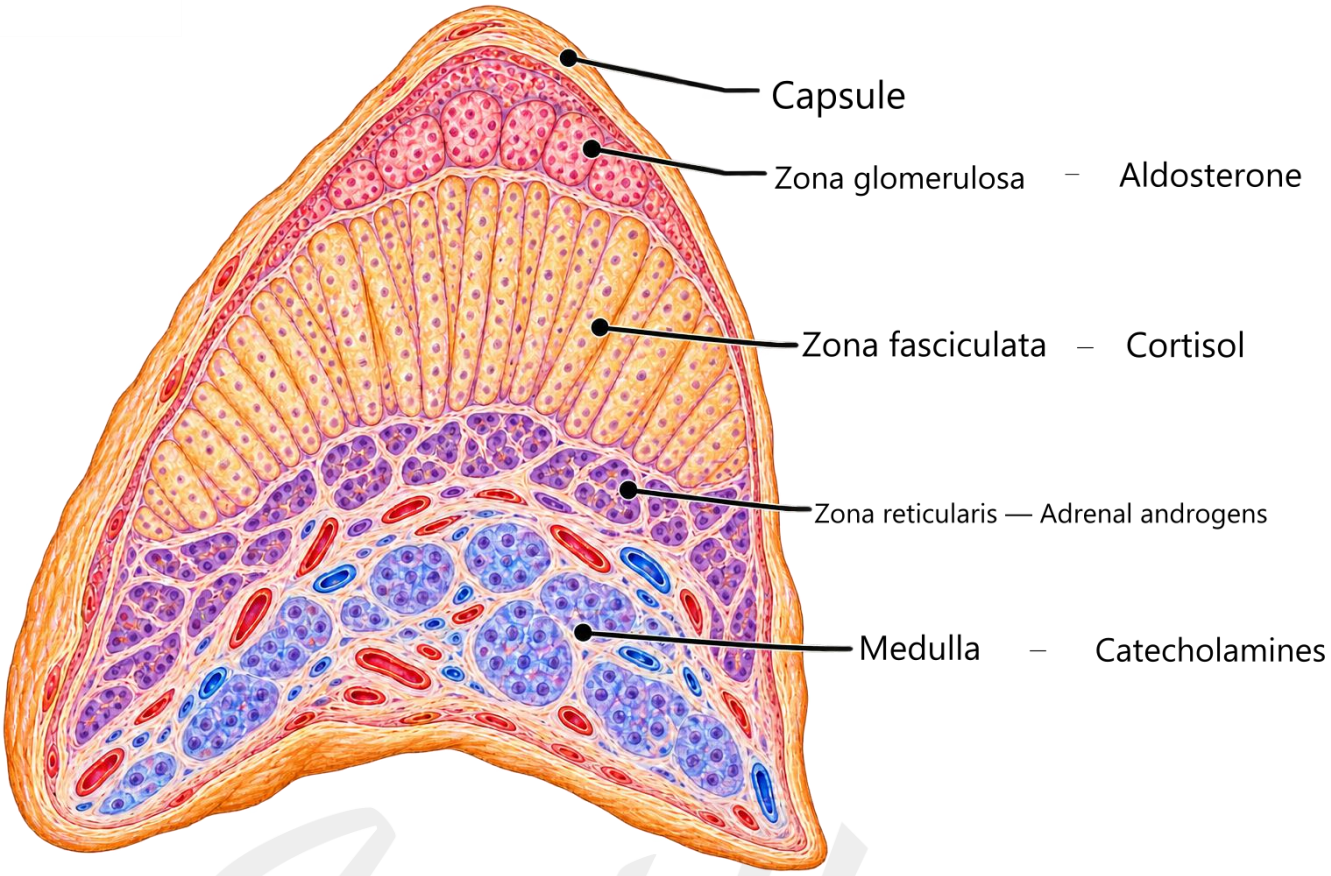
- The right gland is usually pyramidal and lies close to the liver and inferior vena cava.
- The left gland is more crescent shaped and is related anteriorly to the stomach and pancreas.

Arterial Supply and Venous Drainage

- The superior, middle and inferior suprarenal arteries arise from the inferior phrenic, aortic and renal arterial systems respectively.
- The short right adrenal vein drains directly into the inferior vena cava.
- The left adrenal vein usually drains into the left renal vein, often after joining the inferior phrenic vein.
- This asymmetry is important during adrenalectomy and adrenal venous sampling.
- The close vascular relations make careful imaging and controlled dissection essential.

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Cortex and Medulla



The adrenal cortex has three zones surrounding the medulla, with different predominant hormone products

- The outer cortex has three main zones with different predominant products.

A. Adrenal Cortex

- The zona glomerulosa produces aldosterone, which supports sodium retention and potassium excretion.
- The zona fasciculata produces cortisol, which influences metabolism, vascular responsiveness and the stress response.
- The zona reticularis produces adrenal androgens.

B. Adrenal Medulla

- The medulla contains chromaffin cells that release catecholamines under sympathetic stimulation.
- Its chromaffin cells are modified sympathetic cells, which explains their response to preganglionic stimulation.

Hormonal Regulation and Clinical Effects

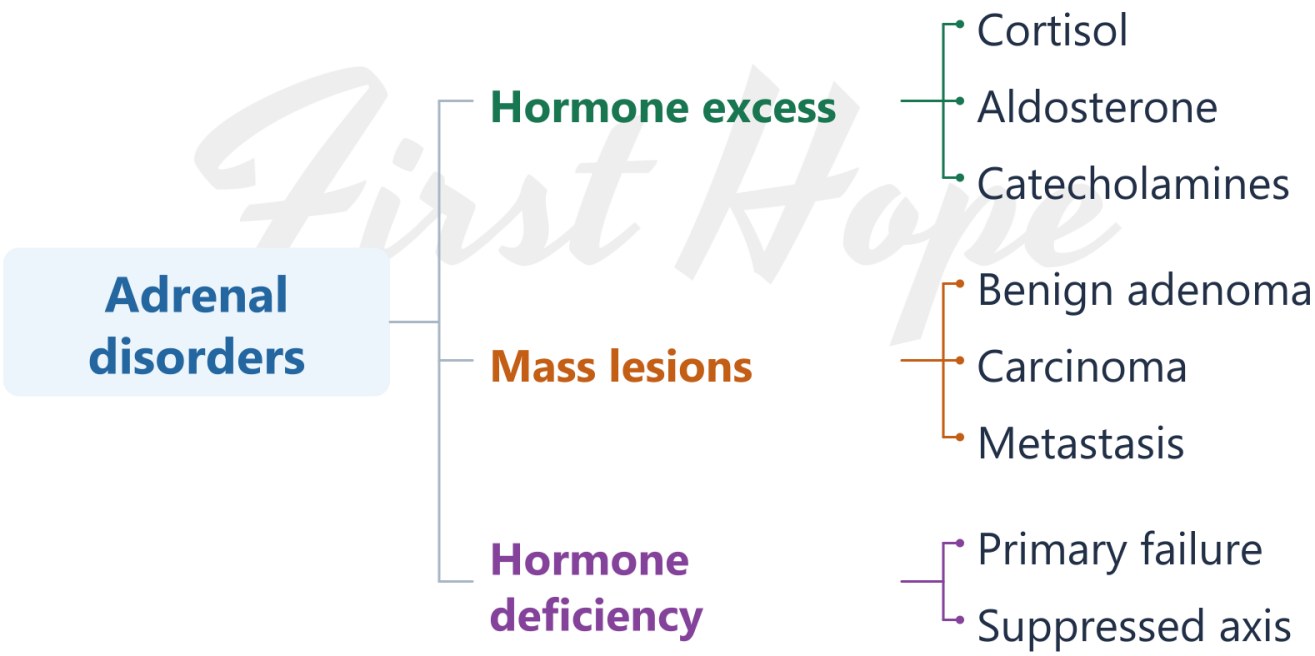
- Aldosterone is regulated mainly through the renin-angiotensin system and potassium, whereas cortisol is controlled mainly by ACTH.
- A lesion can cause symptoms through hormone excess, hormone deficiency, local invasion or an incidental imaging finding.

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Adrenal Regions, Hormones and Excess States

Region	Main product	Important excess state
Zona glomerulosa	Aldosterone supports sodium retention and potassium loss.	Primary aldosteronism causes hypertension with or without hypokalaemia.
Zona fasciculata	Cortisol supports metabolic and stress responses.	Cortisol excess causes Cushing syndrome.
Zona reticularis	Adrenal androgens contribute to androgen production.	Excess may cause virilization in the appropriate context.
Medulla	Catecholamines mediate sympathetic responses.	A functioning phaeochromocytoma can cause cardiovascular instability.

Clinical Approach to Adrenal Disease



History and Examination

Symptoms, Medicines and Previous History

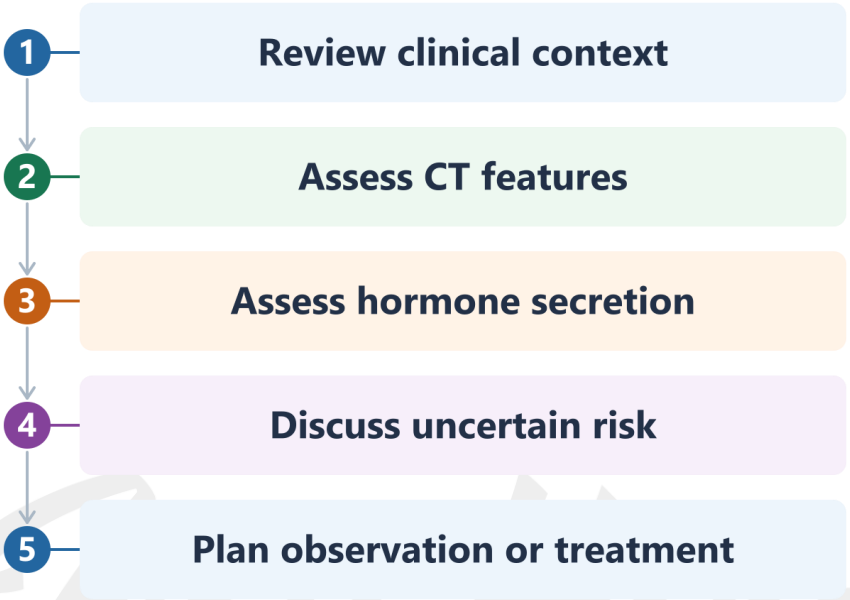
- Ask about blood-pressure problems, weight change, muscle weakness, bruising, glucose intolerance and electrolyte disturbances.
- Episodic headache, sweating and palpitations raise suspicion for catecholamine excess.
- Ask about medicines, including prescribed, inhaled, topical and non-prescribed glucocorticoids.
- Record previous cancer, adrenal imaging, surgery and a family history of endocrine tumours or related syndromes.

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Examination and Important Precautions

- Assess blood pressure, postural change, pulse, hydration, body habitus and features of hormone excess or deficiency.
- Rapid virilization, a large mass or combined hormone excess can raise concern for adrenocortical carcinoma.
- An adrenal lesion should not be biopsied simply because it has been found on a scan.

An Incidental Adrenal Mass



- An adrenal incidentaloma is a mass discovered on imaging undertaken for another reason.
- The main questions are whether it produces excess hormone and whether its imaging features suggest malignancy.

Imaging Risk

- A non-contrast CT assessment considers attenuation, homogeneity, size and other suspicious features.
- A homogeneous lesion with attenuation of 10 Hounsfield units or less on unenhanced CT is strongly consistent with a lipid-rich benign adenoma.
- Under current specialist guidance, such a convincingly benign lesion generally needs no further imaging solely because of its size.
- Heterogeneity, high unenhanced attenuation, invasion or concerning growth requires individualized specialist assessment.

Hormonal Assessment

i. Cortisol Assessment

- A 1-mg overnight dexamethasone suppression test is commonly used to assess autonomous cortisol secretion, with exceptions such as selected frail patients.
- Post-test cortisol of 1.8 micrograms/dL or less, equivalent to 50 nmol/L or less, supports appropriate suppression.

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- A higher value without overt Cushing features may indicate mild autonomous cortisol secretion after considering confounders and confirming the endocrine context.

ii. **Catecholamine Assessment**

- Plasma free or urinary fractionated metanephrines are tested when imaging is not typical of a benign adenoma or the clinical picture suggests phaeochromocytoma.

iii. **Aldosterone and Renin Assessment**

- Hypertension or unexplained hypokalaemia warrants assessment for primary aldosteronism.

Biopsy and Treatment Decisions

- Selected adrenal biopsy is considered only when its result will change management, usually in a cancer-related context, and after phaeochromocytoma has been excluded.
- Biopsy is not the routine way to distinguish a cortical adenoma from an adrenocortical carcinoma.
- The decision between observation and surgery combines imaging, hormonal activity, comorbidities, age and patient preference.

Cushing Syndrome and Cortisol Excess

- Cushing syndrome describes the effects of prolonged glucocorticoid excess, caused either by endogenous cortisol overproduction or by exposure to glucocorticoid medicines.

Definitions and Causes of Glucocorticoid Excess

- Cushing disease specifically refers to an ACTH-secreting pituitary cause and is not a synonym for every form of the syndrome.
- An adrenal adenoma, carcinoma or nodular adrenal disease can produce ACTH-independent cortisol excess.
- Exogenous glucocorticoid exposure is an important alternative cause and should be sought carefully.

Clinical Features and Diagnostic Limits

- Features include central weight gain, proximal muscle weakness, thin skin, easy bruising, broad violaceous striae and impaired wound healing.
- Hypertension, diabetes, osteoporosis, infection risk, mood changes and menstrual or sexual disturbance can occur.
- No single body-shape feature confirms the diagnosis.

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