Adrenal Emergencies in the Hospital Setting

Adrenal emergencies, including adrenal crisis and pheochromocytoma crisis, are life-threatening conditions requiring rapid recognition and management in the hospital. This pamphlet provides students with a guide to recognize, diagnose, and treat these emergencies, including when to consult endocrinology, with clinical scenarios to apply the knowledge.

Clinical Presentation

Adrenal Crisis (Acute Adrenal Insufficiency):

- **Definition:** Life-threatening cortisol deficiency, often in patients with known adrenal insufficiency (AI) or undiagnosed Addison's disease; mortality 10-20% if untreated.
- **Symptoms:** Severe fatigue, nausea/vomiting, abdominal pain, confusion, fever (if infection-triggered), orthostatic symptoms (dizziness, syncope).
- **Triggers:** Infection (e.g., sepsis, pneumonia), surgery, trauma, abrupt steroid withdrawal, adrenal hemorrhage (e.g., Waterhouse-Friderichsen syndrome in meningococcemia).
- **Vitals/Exams:** Hypotension (SBP <90 mmHg, often refractory to fluids), tachycardia, fever or hypothermia, hyperpigmentation (primary AI: ACTH excess), dehydration (dry mucous membranes).

Pheochromocytoma Crisis:

- **Definition:** Catecholamine surge from pheochromocytoma or paraganglioma causing multiorgan dysfunction; mortality 15-30% if untreated.
- **Symptoms:** Severe headache, palpitations, sweating, chest pain (MI mimic), anxiety, nausea/vomiting, visual changes (hypertensive retinopathy).
- **Triggers:** Surgery, anesthesia, trauma, medications (e.g., beta-blockers without alpha-blockade, contrast dye), spontaneous tumor rupture.
- **Vitals/Exams:** Severe hypertension (e.g., BP 220/120 mmHg) or hypotension (catecholamine crash), tachycardia (HR 120-160 bpm), pallor, tremor, retinal hemorrhages.
- **Classic Triad:** Episodic headache, sweating, tachycardia (present in 40% of cases).

Diagnostic Testing and Expected Lab Results

Labs:

- **Adrenal Crisis:Cortisol and ACTH:** Random cortisol <3 mcg/dL (diagnostic in acute setting), ACTH elevated (>100 pg/mL in primary AI).
  - **Electrolytes:** Hyponatremia (Na <135 mEq/L, due to aldosterone deficiency), hyperkalemia (K >5 mEq/L, primary AI), hypoglycemia (glucose <60 mg/dL).
  - **CBC:** Eosinophilia (lack of cortisol suppression), leukocytosis (infection as adrenal crisis trigger).
  - **CMP:** Elevated Cr (dehydration, shock), low bicarbonate (metabolic acidosis).
  - **Renin:** Elevated in primary AI (aldosterone deficiency).
- **Pheochromocytoma Crisis:**
  - **Catecholamines/Metanephrines:** Plasma free metanephrines (normetanephrine >400 pg/mL, epinephrine >100 pg/mL), 24-hour urine metanephrines (elevated 2-3x upper limit).
  - **CMP:** Hyperglycemia (catecholamine-induced), elevated Cr (hypertensive nephropathy), hypercalcemia (rare, MEN2A association).
  - **Troponin:** Elevated if chest pain (demand ischemia or MI from hypertension).
  - **Other:** Elevated lactate (shock, tissue hypoperfusion), leukocytosis (stress response).

Imaging:

- **Adrenal Crisis:**
  - **CT Adrenal:** Adrenal hemorrhage (bilateral, e.g., Waterhouse-Friderichsen), atrophy (autoimmune Addison's), or mass (metastasis causing AI).
  - **Chest X-ray:** Rule out infection (pneumonia as trigger).
- **Pheochromocytoma Crisis:**
  - **CT/MRI Abdomen:** Adrenal mass (pheochromocytoma, 90% unilateral, 10% bilateral), extra-adrenal paraganglioma (10-20% of cases).
  - **MIBG Scan:** Confirms catecholamine-producing tumor (not emergent, for surgical planning).

Other Tests:

- **Adrenal Crisis:** Cosyntropin stimulation test (cortisol <18 mcg/dL at 60 min confirms AI).
- **Pheochromocytoma Crisis:** EKG (tachycardia, ischemic changes), echocardiogram (takotsubo cardiomyopathy, LV dysfunction from catecholamine surge).

Diagnostic Testing Table

Test	Condition	Expected Results	Notes
Cortisol, ACTH	Adrenal Crisis	Cortisol <3 mcg/dL, ACTH >100 pg/mL	Random cortisol in acute setting.
Plasma Metanephrines	Pheochromocytoma Crisis	Normetanephrine >400 pg/mL	Urine metanephrines if stable.
Electrolytes	Adrenal Crisis	Na <135 mEq/L, K >5 mEq/L	Hypoglycemia common in children.
CT Abdomen	Pheochromocytoma Crisis	Adrenal mass (unilateral/bilateral)	MIBG scan for surgical planning.

Treatment

General Principles:

- Stabilize the patient (e.g., airway, fluids, BP control).
- Treat underlying triggers (e.g., infection, tumor rupture).
- Monitor closely (telemetry, frequent vitals, labs).

Adrenal Crisis:

- **Stress-Dose Steroids:**
  - Hydrocortisone 100 mg IV bolus, then 50 mg IV q6h, taper once stable (e.g., 50 mg IV q8h, then PO).
  - **Alternative:** Dexamethasone 4 mg IV bolus (if cosyntropin test planned; doesn't interfere with cortisol assay), then switch to hydrocortisone.
- **Fluid Resuscitation:** Normal saline (NS) 1-2 L IV bolus, then 100-200 mL/h (corrects dehydration, hyponatremia); monitor for fluid overload.
- **Electrolyte Correction:**
  - **Hyperkalemia:** Calcium gluconate 1 g IV (if ECG changes), insulin 10 units IV + D50 50 mL IV (drives K into cells).
  - **Hypoglycemia:** Dextrose 50 mL IV (D50) if glucose <60 mg/dL.
- **Supportive:**
  - Treat infection (e.g., ceftriaxone 1 g IV daily + vancomycin 15 mg/kg IV q12h for sepsis).
  - ICU admission if shock (pressor-refractory hypotension), altered mental status, or respiratory failure.

Pheochromocytoma Crisis:

- **BP Control (Alpha-Blockade First):**
  - Phentolamine 1-5 mg IV bolus q5min or infusion 0.5-1 mg/min (alpha-blocker, titrate to BP <160/90 mmHg).
  - **Alternative:** Nicardipine 5-15 mg/h IV infusion (calcium channel blocker, if alpha-blocker unavailable).
- **Beta-Blockade (After Alpha-Blockade):**
  - Propranolol 1-2 mg IV q4-6h or 20-40 mg PO q6h (only after alpha-blockade to prevent unopposed alpha-mediated vasoconstriction).
  - **Alternative:** Esmolol 50-100 mcg/kg/min IV infusion (titratable, short half-life).
- **Surgical Preparation:**
  - Once stable, prepare for tumor resection (alpha-blockade for 7-14 days pre-op: phenoxybenzamine 10 mg PO BID, titrate to 20-40 mg BID).
  - IV fluids (NS 1-2 L bolus pre-op to prevent post-resection hypotension).
- **Supportive:**
  - ICU admission for BP monitoring, telemetry (tachycardia, arrhythmias).
- **Treat complications:** tPA 100 mg IV over 2h (if acute MI), nitroglycerin 5-20 mcg/min IV (if chest pain, no hypotension).
- Avoid beta-blockers without alpha-blockade (worsens hypertensive crisis).

Treatment Guidelines Table

Condition	Treatment	Agent/Dose	Notes
Adrenal Crisis	Steroids + Fluids	Hydrocortisone 100 mg IV bolus -NS 1-2 L IV bolus	Taper steroids once stable; treat infection.
Adrenal Crisis	Electrolyte Correction	Insulin 10 units IV + D50 50 mL IV	For hyperkalemia; dextrose for hypoglycemia.
Pheochromocytoma Crisis	Alpha-Blockade + Beta-Blockade	Phentolamine 1-5 mg IV q5min -Propranolol 1-2 mg IV q4h	Alpha-blockade first; ICU for BP monitoring.
Pheochromocytoma Crisis	Surgical Preparation	Phenoxybenzamine 10 mg PO BID	Pre-op alpha-blockade 7-14 days.

Endocrine Consults

Indications:

- **Diagnostic Uncertainty:** Suspected adrenal insufficiency with atypical labs (e.g., normal cortisol but severe symptoms).

- **Severe Cases:** Adrenal crisis (refractory hypotension, multiorgan failure), pheochromocytoma crisis (hypertensive emergency, surgical planning).
- **Refractory Symptoms:** Persistent shock, uncontrolled BP, or catecholamine surge despite initial therapy.
- **Comorbidities:** Coexisting endocrine disorders (e.g., MEN2A with pheochromocytoma, hypopituitarism with secondary AI).
- **Long-Term Management:** Post-crisis care (e.g., steroid tapering in AI, surgical planning for pheochromocytoma).

Timing:

- **Urgent:** Adrenal crisis, pheochromocytoma crisis, or severe complications (e.g., MI, stroke, shock).
- **Routine:** Stable patients for long-term management (e.g., glucocorticoid replacement, genetic testing for MEN syndromes).

Complications

Adrenal Crisis:

- Multiorgan failure (shock → renal, hepatic failure), arrhythmia (hyperkalemia → peaked T waves, VT/VF), death (mortality 10-20% if untreated).
- Hypoglycemic seizures (especially in children), adrenal hemorrhage (bilateral, e.g., in sepsis).

Pheochromocytoma Crisis:

- Stroke (hypertensive crisis), MI (catecholamine-induced), takotsubo cardiomyopathy (LV dysfunction), ARDS (pulmonary edema), death (mortality 15-30%).
- Tumor rupture (rare, massive catecholamine release → shock, hemorrhage).

Key Pearls

- **Adrenal Crisis:** Suspect in hypotensive patients with AI history or triggers (e.g., infection, steroid withdrawal); treat with hydrocortisone + fluids before labs confirm.
- **Pheochromocytoma Crisis:** Severe hypertension with headache, palpitations, sweating; alpha-blockade first, then beta-blockade; avoid beta-blockers alone.
- **Electrolytes:** Hyponatremia + hyperkalemia = primary AI; hypoglycemia common in adrenal crisis (treat with dextrose).
- **Imaging:** CT abdomen for adrenal hemorrhage (crisis) or mass (pheochromocytoma); MIBG scan for surgical planning (not emergent).

- **ICU:** Admit for adrenal crisis (shock, altered mental status) and pheochromocytoma crisis (BP control, telemetry).
- **Endocrine Consult:** Urgent for life-threatening cases; routine for long-term management (e.g., steroid dosing, tumor resection).

References

- **UpToDate:** “Adrenal Crisis: Diagnosis and Management” (2025).
- **NEJM:** “Pheochromocytoma and Paraganglioma: Diagnosis and Treatment” (2024).
- **Endocrine Reviews:** “Critical Care Management of Adrenal Insufficiency” (2023).
- **J Clin Endocrinol Metab:** “Pheochromocytoma Crisis: A Review” (2024).

Clinical Scenarios

Case 1: A 45-Year-Old Male with Hypotension

- **Presentation:** A 45-year-old male with Addison’s disease (noncompliant with hydrocortisone) presents with nausea, vomiting, and dizziness for 2 days after a URI. Exam: BP 80/50 mmHg, HR 110 bpm, dry mucous membranes, hyperpigmentation.
- **Labs:** Na 130 mEq/L, K 5.8 mEq/L, glucose 55 mg/dL, cortisol 2 mcg/dL, ACTH 150 pg/mL.
- **Diagnosis:** Adrenal Crisis → Hypotension, hyponatremia, hyperkalemia, low cortisol, history of AI.
- **Management:** Hydrocortisone 100 mg IV bolus, then 200 mg IV over 24h. NS 2 L IV bolus, then 150 mL/h. Dextrose 50 mL IV (D50) for hypoglycemia. Calcium gluconate 1 g IV + insulin 10 units IV + D50 50 mL IV for hyperkalemia. Treat infection (ceftriaxone 1 g IV daily for suspected URI). Urgent endocrine consult. ICU admission for refractory hypotension. Monitor telemetry, electrolytes, and glucose.

Case 2: A 50-Year-Old Female with Hypertensive Crisis

- **Presentation:** A 50-year-old female presents with severe headache, sweating, and palpitations for 1 day after starting a beta-blocker for HTN. Exam: BP 230/130 mmHg, HR 140 bpm, tremor, retinal hemorrhages.
- **Labs:** Plasma normetanephrine 600 pg/mL, glucose 180 mg/dL, troponin 0.5 ng/mL (elevated).
- **Imaging:** CT abdomen: 4 cm left adrenal mass.
- **Diagnosis:** Pheochromocytoma Crisis → Hypertensive emergency, classic triad (headache, sweating, tachycardia), adrenal mass.

- **Management:** ICU admission. Phentolamine 2 mg IV q5min (titrate to BP <160/90 mmHg). After alpha-blockade, propranolol 1 mg IV q4h (target HR <100 bpm). NS 1 L IV bolus (pre-op volume expansion). Prepare for surgery (phenoxybenzamine 10 mg PO BID, titrate). Urgent endocrine consult. Monitor telemetry (tachycardia, ischemic changes), BP, and lactate.

Case 3: A 30-Year-Old Female with Postpartum Shock

- **Presentation:** A 30-year-old female, 2 weeks postpartum, presents with fever, confusion, and hypotension. Exam: BP 85/55 mmHg, HR 120 bpm, diffuse rash (meningococcemia suspected). History of Sheehan's syndrome (postpartum pituitary necrosis).
- **Labs:** Na 132 mEq/L, K 4.0 mEq/L (secondary AI), cortisol 1 mcg/dL, ACTH 10 pg/mL (low, pituitary failure).
- **Imaging:** CT adrenal: Bilateral adrenal hemorrhage (Waterhouse-Friderichsen syndrome).
- **Diagnosis:** Adrenal Crisis (Secondary AI) → Postpartum shock, low cortisol, adrenal hemorrhage, Sheehan's syndrome history.
- **Management:** Hydrocortisone 100 mg IV bolus, then 50 mg IV q6h. NS 2 L IV bolus, then 200 mL/h. Treat meningococcemia (ceftriaxone 2 g IV q12h + vancomycin 15 mg/kg IV q12h). ICU admission for shock. Urgent endocrine consult. Monitor telemetry, mental status, and Na correction.