ADRENAL INSUFFICIENCY IN CHILDREN & ADOLESCENTS: Recognizing adrenal crisis & its treatment for school nurses

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Clinical case

- A 15 year old adolescent boy presents to the school nurse complaining about dizziness upon standing. He has morning headaches, which frequently make him late for school. Appetite is poor, and he has been losing weight. His grades have suffered in the past few months. Which of the following conditions might you suspect?
  - A. Anorexia
  - B. Infectious mononucleosis
  - C. Depression
  - D. Adrenal insufficiency
  - E. All of the above

Take home point #1:

Signs & symptoms of adrenal insufficiency (AI) mimic other chronic conditions

- Fatigue, lethargy, depression, confusion
- Headaches, dizziness
- Anorexia, vomiting
- Dehydration, low blood pressure, syncope (fainting) or shock
- Tan skin pigmentation
- Metabolic disequilibrium: Low blood glucose, sodium and high potassium levels

Take home point #2: Careful *family history* can identify AI cause

- Is there a relative with adrenal insufficiency?
  - At what age was it diagnosed?
- Do autoimmune diseases run in the family? (eg, Type 1 diabetes, Graves disease, hypothyroidism)
- Were there any unexplained early infant or childhood deaths?

Affirmative answers to these questions may suggest a genetically transmitted condition.

Take home point #3: Careful *medical history* can identify AI cause

- At what age did the child first experience symptoms or signs of a medical problem?
  - *If in early infancy, a congenital or genetic disorder is likely*
- Does the child have a past history of any other medical problems?
  - *A recent serious infection could have triggered AI*
- Has s/he been hospitalized for this? And is there a known diagnosis?
- Has s/he had surgery? What type of procedure?
  - *Removal of, or damage to, the adrenal or pituitary could trigger AI*
- Has the child taken any medication(s) or been exposed to any toxins?
  - *Long-term steroid administration may suppress innate adrenal function. Risk of AI if suddenly stopped*
  - *Some medications or toxins interfere with adrenal function*
- Has the family or physician observed any unusual changes in the child's behavior or daily function?
  - *Deteriorating cognitive or motor function could signal a neurodegenerative disorder (eg ALD).*

Causes of *Primary* Adrenal Insufficiency

Congenital

- Enzyme deficiency:
  - *Congenital adrenal hyperplasia*
- Storage disease
  - Wolman disease
- Developmental defect
  - Adrenal hypoplasia congenita
- Receptor defect
  - ACTH resistance
  - Glucocorticoid resistance

Acquired

- Autoimmune
  - Addison disease
- Infectious
  - Meningococci
  - AIDS
  - Tuberculosis
  - Covid 19
- Trauma
- Iatrogenic
  - Drugs: Ketoconazole
- Toxins: Metals

Syndromes

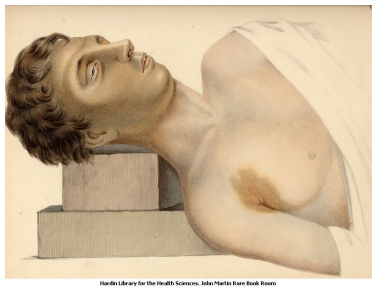
- Storage:
  - *Adrenoleukodystrophy*
- Mitochondrial:
  - Kearns-Sayre
- Receptor resistance:
  - Allgrove syndrome
  - IMAGE

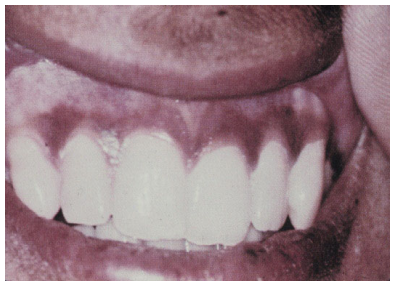
Causes of Secondary Adrenal Insufficiency

- Pituitary trauma/surgery
- Brain tumors
  - Craniopharyngioma
  - Suprasellar germ cell tumor
- Infiltrative pituitary disease
  - Sarcoidosis
  - Histiocytosis
- Congenital pituitary abnormalities
  - May have progressive loss of corticotropin function
- Chronic glucocorticoid therapy

Take home point #4:
Careful physical examination can aid diagnosis

- Hyperpigmentation: Tan skin in non-exposed areas
- Vitiligo (in autoimmune AI): Loss of melanin-skin pigment
- Cardiovascular instability: Low BP, fainting, shock
- Loss of axillary/pubic hair





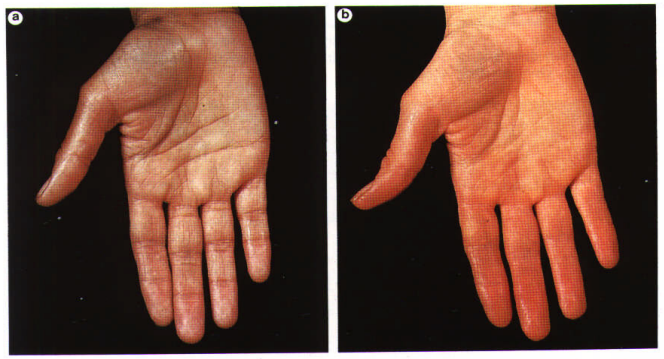


Fig. 8.3 Pigmentation of the palmar creases of the hands in a patient with Addison's disease. Pigmentation in Addison's disease commonly occurs in areas exposed to light and pressure. It is usually seen in the skin creases, as shown in view (a). During treatment (b) the normal colour returns.

Take home point #5:
Deteriorating vital signs are clues to impending crisis

- Your patient has a low blood pressure of 90/60
- Pulse is rapid & weak pulse at 124 bpm
- When he rises from a supine position he nearly faints
- BP is now 80/55 and pulse 144 bpm

What are the next most appropriate steps?

Take home point #6:
Acute adrenal insufficiency demands prompt treatment

- Acute treatment:
  - Stress doses of glucocorticoid (hydrocortisone as Solu-Cortef by IM or IV injection), followed by every 6 hour dosing until crisis has resolved (usually 24-48hrs)
    - 50 mg for elementary school students
    - 100 mg for high school students
  - CALL 9-1-1
  - EMT to add liberal volumes of electrolyte-containing IV fluids (normal saline or lactated Ringers)
  - Continuous medical observation for ~12-24 hours
- Chronic treatment:
  - Near-physiologic glucocorticoid doses of oral hydrocortisone divided 2-3 x daily
    - Adjust according to patient's sense of well-being & function
    - Mild illness may require a doubling or tripling of daily oral dosing, given every 6 hours
    - Midday dosing helps reduce fatigue
  - Daily mineralocorticoid & sodium supplements as needed
    - Salt-craving and/or intense physical activity inducing excessive perspiration indicate(s) the need for these extra treatments

How-to videos for giving children Solucortef injections

https://www.youtube.com/watch?v=bjKE0IkP0QI

https://www.youtube.com/watch?v=moSz5ZoTJFE

PowerPoint Slides:
https://www.nadf.us/uploads/1/3/0/1/130191972/nadf_solucortef_im_admin_training.pdf

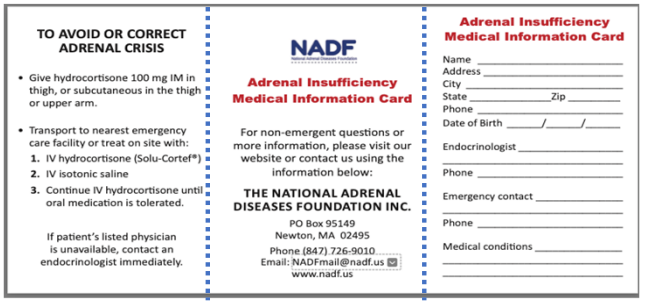
Take home point #7:
Who should be treated with stress doses of glucocorticoids?

- Congenital or acquired forms of primary or secondary adrenal insufficiency
  - Especially at times of gastrointestinal illness, fever >101F, or at surgery
- Any patient treated with pharmacologic doses of glucocorticoids for >2 wks within the past year experiencing one of the above stressful situations
- Endocrinologists should educate patients & families of the need to get stress dosing, when to give HC injections, and call 911.
  - Parents must share this written information with school health dept
  - Patients must carry emergency instructions and/or wear a medical alert tag prominently
  - Students with AI should be accompanied by a knowledgeable adult on school trips

Adrenal Crisis Emergency Preparation Best Practices

NADF Emergency Kit Recommendations

- Your emergency contact and endocrinologist's information
- NADF Emergency Care Crisis Alert Flyer
- Adrenal Crisis Care Letter For Emergency Staff (signed by your endocrinologist)
- EHR login and Password
- Solu-Cortef Act-O-Vial
- Syringe
- Needles
- Alcohol swabs



TO AVOID OR CORRECT ADRENAL CRISIS

- Give hydrocortisone 100 mg IM in thigh, or subcutaneous in the thigh or upper arm.
- Transport to nearest emergency care facility or treat on site with:
  1. IV hydrocortisone (Solu-Cortef®)
  2. IV isotonic saline
  3. Continue IV hydrocortisone until oral medication is tolerated.

If patient's listed physician is unavailable, contact an endocrinologist immediately.

NADF

Adrenal Insufficiency Medical Information Card

For non-emergent questions or more information, please visit our website or contact us using the information below:

THE NATIONAL ADRENAL DISEASES FOUNDATION INC.

PO Box 95149
Newton, MA 02495
Phone (847) 726-9010
Email: NADFmail@nadf.us
www.nadf.us

Adrenal Insufficiency Medical Information Card

Name _____
Address _____
City _____
State _____ Zip _____
Phone _____
Date of Birth ____/____/____

Endocrinologist _____
_____
Phone _____

Emergency contact _____
_____
Phone _____

Medical conditions _____
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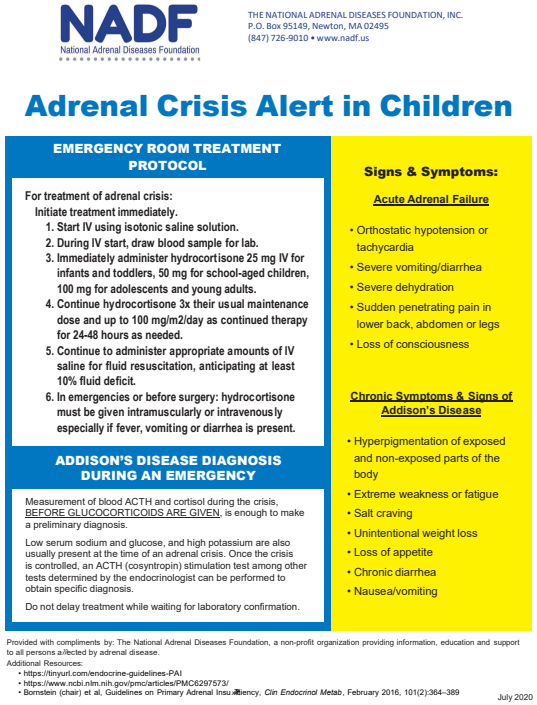
_____

NADF Emergency Card



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National Adrenal Diseases Foundation

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Adrenal Crisis Alert in Children

EMERGENCY ROOM TREATMENT PROTOCOL

For treatment of adrenal crisis:
Initiate treatment immediately.

1. Start IV using isotonic saline solution.
2. During IV start, draw blood sample for lab.
3. Immediately administer hydrocortisone 25 mg IV for infants and toddlers, 50 mg for school-aged children, 100 mg for adolescents and young adults.
4. Continue hydrocortisone 3x their usual maintenance dose and up to 100 mg/m2/day as continued therapy for 24-48 hours as needed.
5. Continue to administer appropriate amounts of IV saline for fluid resuscitation, anticipating at least 10% fluid deficit.
6. In emergencies or before surgery: hydrocortisone must be given intramuscularly or intravenously especially if fever, vomiting or diarrhea is present.

ADDISON'S DISEASE DIAGNOSIS DURING AN EMERGENCY

Measurement of blood ACTH and cortisol during the crisis, BEFORE GLUCOCORTICOIDS ARE GIVEN, is enough to make a preliminary diagnosis.

Low serum sodium and glucose, and high potassium are also usually present at the time of an adrenal crisis. Once the crisis is controlled, an ACTH (cosyntropin) stimulation test among other tests determined by the endocrinologist can be performed to obtain specific diagnosis.

Do not delay treatment while waiting for laboratory confirmation.

Signs & Symptoms:

Acute Adrenal Failure

- Orthostatic hypotension or tachycardia
- Severe vomiting/diarrhea
- Severe dehydration
- Sudden penetrating pain in lower back, abdomen or legs
- Loss of consciousness

Chronic Symptoms & Signs of Addison's Disease

- Hyperpigmentation of exposed and non-exposed parts of the body
- Extreme weakness or fatigue
- Salt craving
- Unintentional weight loss
- Loss of appetite
- Chronic diarrhea
- Nausea/vomiting

Provided with compliments by: The National Adrenal Diseases Foundation, a non-profit organization providing information, education and support to all persons a/lected by adrenal disease.

Additional Resources:
- https://tinyurl.com/endocrine-guidelines-PAI
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6297573/
- Bornstein (chair) et al, Guidelines on Primary Adrenal Insufficiency, *Clin Endocrinol Metab*, February 2016, 101(2):364–389

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NADF Tools for Life > Emergency Handouts

Summary: Treatment of AI

- Hydrocortisone = glucocorticoid drug of choice for all
  - Maintenance dose ~10-15 mg/kg/day, divided in 3 doses
    - Lower maintenance doses in Addison disease vs CAH
    - Higher doses in stress (3x maintenance q6h)
    - Parenteral dosing for crisis Solucortef 100/50/25 mg IM/IV stat & 100 mg/m2/day divided q6h til stable
- Fludrocortisone 0.05-0.2 mg daily in 1-2 divided doses
  - Use in all classic CAH infants and any AI pt with high renin
- NaCl ~1 gram daily
  - Use in classic CAH infants and AI patients with high renin

Questions?