Child With Suspected Hyperglycemia

Suggestive history and physical findings	Initial laboratory and/or radiologic work-up can include:	When to refer	Items useful for consultation	Additional information
Symptoms/Signs: Polyuria, nocturia, enuresis, increased thirst, increased appetite, unexpected weight loss, fatigue, and menstrual irregularity. May be asymptomatic and present with hyperglycemia during inter-current illness or with the use of medications like glucocorticoids. Family history: Diabetes Pertinent Physical signs: Lean, Overweight or obese Acanthosis nigricans Differential Diagnosis	**Blood tests:** • Random blood glucose **Urine tests:** • Urine glucose and ketones Other tests to consider after consultation with Pediatric Endocrinologist: • Fasting blood glucose • CMP • Hemoglobin A1c • Complete blood count • Oral glucose tolerance test • c-peptide • Diabetes antibodies: islet cell, IA-2, insulin, GAD-65, ZnT8	**Prompt:** all cases of pre-diabetes **Urgent:** All cases of diabetes defined as fasting blood glucose > 126 mg/dl, random blood glucose > 200 mg/dl or 2 hour post prandial glucose > 200 mg/dl after glucose load of 1 gm/kg, or HbA1c > 6.5% should be referred to a pediatric diabetes center or a pediatric endocrinologist. **Emergent:** -Ill appearing child -Ketones in urine : should be referred to emergency department for management and possible admission Find a Pediatric Endocrinologist	Previous growth data/growth charts Pertinent medical records Recent laboratory and radiologic studies	Additional Information Type 1 Diabetes: A Guide for Families Type 2 Diabetes: A Guide for Families References

Differential diagnosis for hyperglycemia

- Type 1 diabetes (T1DM),
- Type 2 diabetes (T2DM)
- Chemical/medication induced diabetes
- Stress induced hyperglycemia
- Monogenic Onset Diabetes of Young/Maturity onset diabetes of Young (MODY)

Additional Information

Laboratory Abnormalities:

- Pre-diabetes is defined as fasting blood glucose: 100-125 mg/ dl, 2 hour post prandial glucose: 140-200 mg/dl after glucose load of 1 gm/kg (maximum dose: 75 gm) or HbA1c: 5.7-6.4%.
- Diabetes is defined as fasting blood glucose $\geq$ 126 mg/dl, 2 hour post prandial glucose $\geq$ 200 mg/dl after glucose load of 1 gm/ kg (maximum dose: 75 gm), HbA1c $\geq$ 6.5% or random blood glucose $\geq$ 200 mg/dl in patient with classic symptoms of hyperglycemia.
    - In the absence of unequivocal hyperglycemia, result should be repeated.
- Simultaneous c-peptide level is elevated in stress induced hyperglycemia and T2DM, variable in chemical/medication induced diabetes and inappropriately normal or low in MODY and T1DM.
- Pancreatic autoantibodies: islet cell antibodies (ICA), GAD-65, insulin antibodies, IA2A and ZnT8 are detected only in T1DM.
    - Most commercial laboratories may have the assays to test for some/ most of the autoantibodies accurately.
    - **Should be done after discussion with endocrinologist.**
- Electrolyte abnormalities: pseudo-hyponatremia (secondary to blood glucose elevation), elevated blood urea nitrogen and creatinine (secondary to dehydration), abnormal liver function tests.

Diagnosis and management:

- Stress hyperglycemia
    - May be seen in individuals at risk for diabetes.

    - Can be seen with inter-current illness, treated conservatively with education, close monitoring and treatment of the underlying illness.
    - Insulin treatment may be needed rarely during acute illness especially in ICU setting.
    - Hyperglycemia typically resolves with resolution of underlying illness.
- Chemical/Medication induced diabetes
    - Hyperglycemia noted with use of certain medications e.g. glucocorticoids, albuterol, chemotherapy, anti-rejection medications
    - Insulin treatment may be needed for glycemic control
    - Hyperglycemia may resolve after discontinuation of medication.
- MODY
    - Most cases of MODY are mislabeled initially as Type 1 or Type 2 diabetes.
    - Inherited in autosomal dominant pattern- strong family history of diabetes in family members in multiple generations
    - MODY should be suspected in individuals treated as type 1 diabetes in whom insulin requirement remains low and pancreatic autoantibodies are negative.
    - MODY may be suspected in individuals treated as type 2 diabetes, who are not markedly obese, do not have significant acanthosis, have strong family history of diabetes and fasting c-peptide level is low or normal.
    - Diagnosis of MODY is made by DNA testing for genetic mutations.
    - Treatment
        - MODY 2: have mildly elevated blood glucose, do not progress overtime and do not need treatment with sulfonylurea or exogenous insulin in the pediatric ages.
        - Oral medication (sulfonylurea): MODY type 1 (hepatocyte nuclear factor (HNF) 1a) and type 3 (HNF 4a) are exquisitely sensitive to sulfonylurea.
        - Insulin treatment: Needed as disease progresses and in other forms of MODY.

Suggested References and Additional Reading

- American Diabetes A. Standards of medical care in diabetes-2015 abridged for primary care providers. Clinical diabetes: a publication of the American Diabetes Association. 2015;33(2):97-111. Epub 2015/04/22. doi: 10.2337/diaclin.33.2.97. PubMed PMID: 25897193; PubMed Central PMCID: PMC4398006. http://clinical.diabetesjournals.org/content/33/2/97.full.pdf+html
- Monogenic diabetes in children- ISPAD guideline. http://www.ceed3.org/en/node/158.

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