Disclosure to Participants

- Notice of Requirements for Successful Completion
  - Please refer to learning goals and objectives
  - Learners must attend the full activity and complete the evaluation in order to claim continuing education credits.
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  - Advisory Boards: Dr. P. E. Cryer
  - Speaker's Bureau: Dr. P. E. Cryer
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  - Content of this slide has not been endorsed or approved by the American Diabetes Association (ADA), American Association of Diabetes Educators (AADE), or other diabetes-related organizations.
- Other
  - The content of this slide may be edited to fit the educational activity.

Assessment, Treatment, and Prevention of Hypoglycemia in Diabetes

Objectives

- Review classifications of hypoglycemia
- Assessment strategies for identifying individuals at risk for hypoglycemia
- Learn clinical recommendations for those at risk for hypoglycemia
- Review treatment recommendations for hypoglycemia
- Incorporate strategies into clinical practice that are known to prevent hypoglycemia

Consequences of Hypoglycemia

- Seizures
- Coma
- Fear
- Quality of life
- Cognitive dysfunction
- Prevents desirable glucose targets
- Cardiovascular Risk

Hypoglycemia risk should not keep us from optimizing glucose control. It means we, the provider/educator should work smarter and help those with diabetes be smarter.

Case Study

- Introduction
  - Mr. L., a 67-year-old obese man (35 kg/m²) was diagnosed with type 2 diabetes 14 years ago
  - Initial treatment strategy included lifestyle modification (nutrition and physical activity) with metformin 500 mg BID and glyburide 20 mg once daily

Case Study (cont’d)

- Mr. L.’s Follow-up Visit:
  - Worsening glucose control for several months, notes burning sensation in his feet
  - A1C: 9.4%, FBG 198 mg/dL and PPBG 255 mg/dL
  - Medications changed as a result:
    - metformin 1000 mg BID, glimepiride 2 mg once daily, and basal insulin 20 units at HS

Case Study (cont’d)

- After change in meds:
  - FBG 65 to 160 mg/dL and PPBG 100-245 mg/dL
  - Occasional symptoms of hypoglycemia between 9-10 am
  - Patient’s wife told the doctor that last week her husband was “acting confused and irritable” and sweating profusely. The situation resolved after some apple juice
  - The patient doesn’t remember the incident

What is your first question?

- What did you eat for breakfast?
- How often are you having low blood glucose reading?
- Do you drink adult beverages (alcohol)?
- What time did you take your medication?

Assessment of Hypoglycemia

- Does the individual have symptoms?
  - At what level does the individual feel low?
  - Do they monitor their blood glucose level?
Clinical Manifestations of Hypoglycemia

**Autonomic**
- Sweating
- Tachycardia
- Anxiety/Arousal
- Widened pulse-pressure
- Paresthesia
- Tremulousness
- Palpitations

**Neuroglycopenic**
- Dizziness
- Hypothermia
- Headache
- Cognitive Dysfunction
- Behavioral changes
- Confusion
- Coma
- Seizure
- Death

Normal Hormone Responses to Hypoglycemia

- Insulin (80-85 mg/dL)
- Glucagon (65-70 mg/dL)
- Epinephrine (65-70 mg/dL)
- Growth Hormone (65-70 mg/dL)
- Cortisol (55-60 mg/dL)

ADA Classification of Hypoglycemia in Diabetes

<table>
<thead>
<tr>
<th>Level</th>
<th>Glycemic Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose alert value (level 1)</td>
<td>≤70 mg/dL (3.9 mmol/L)</td>
<td>Sufficiently low for treatment with fast-acting carbohydrate and dose adjustment of glucose-lowering therapy</td>
</tr>
<tr>
<td>Clinically significant hypoglycemia (level 2)</td>
<td>&lt;54 mg/dL (3.0 mmol/L)</td>
<td>Sufficiency low to indicate severe, clinically important hypoglycemia</td>
</tr>
<tr>
<td>Severe hypoglycemia (level 3)</td>
<td>No specific glucose threshold</td>
<td>Hypoglycemia associated with severe cognitive impairment requiring external assistance for recovery</td>
</tr>
</tbody>
</table>

ADA Classification of Hypoglycemia in Diabetes

- How many readings on the meter are under 70?
- Ask the individual, at what level they usually feel a low blood glucose?
- What are your symptoms?
- Have you had any episodes that you were unable to treat yourself?

Risk factors for hypoglycemia-associated autonomic failure (impaired hypoglycemia awareness)

- Absolute endogenous insulin deficiency
- A history of severe hypoglycemia, hypoglycemia unawareness, or both as well as recent antecedent hypoglycemia, prior exercise, and sleep
- Aggressive glyceremic therapy per se (lower HbA1c levels, lower glyceremic goals, or both)

Nocturnal Hypoglycemia

- The neuroendocrine defense mechanism is markedly blunted against hypoglycemia during sleep by shifting the glycemic threshold for counterregulatory activation to lower levels
- Although symptoms of hypoglycemia trigger awakening in healthy subjects, individuals with type 1 diabetes frequently fail to awake in the presence of low plasma glucose levels

Nocturnal Hypoglycemia

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Assessment of Hypoglycemia

• Does the individual have symptoms?
• What were the precipitating factors?

Risk factors for hypoglycemia in diabetes

• Conventional risk factors – relative or absolute insulin excess
  – Insulin or insulin secretagogue doses are excessive, ill-timed, or of the wrong type
  – Exogenous glucose delivery is decreased (e.g. after missed meals and during the overnight fast)
  – Glucose utilization is increased (e.g. during exercise, early pregnancy)
  – Endogenous glucose production is decreased (e.g. after alcohol ingestion)
  – Sensitivity to insulin is increased (e.g. after weight loss, an increase in regular exercise or improved glycemic control, and in the middle of the night)
  – Insulin clearance is decreased (e.g. with renal failure)

Risk factors for hypoglycemia in diabetes in the elderly

• Use of insulin or insulin secretagogues
• Duration of diabetes
• Antecedent hypoglycemia
• Erratic meals
• Renal insufficiency

Medication Risk of Hypoglycemia By Class

• More risk
  – Insulin
  – Sulfonylureas

• Less risk
  – Metformin
  – GLP-1 agonist
  – SGLT-2 inhibitors
  – DPP-IV inhibitors

Challenge of Accurately Measuring Blood Glucose Levels

Point-of-care blood glucose meters (SMBG)

• 95% of all blood glucose values must be within 15% of the true value
• 99% of meter values must be within 20% of true value

Continuous glucose monitors (CGM)

• Improving accuracy, reduces time in hypoglycemia but mixed results in reducing severe hypoglycemia
• Not recommended for glycemic management of hospitalized patients (at this time)
This information may be out of data--FDA recently updated SMBG accuracy requirements. Newer CGMs are likely more accurate. So good instinct to delete--would need to update if you want to keep with current numbers.

Erika Gebel, 3/30/2017
Assessment of Hypoglycemia

- Does the individual have symptoms?
- What were the precipitating factors?
- How is the individual treating hypoglycemia?
- How can we prevent hypoglycemia?

ADA Recommendations: Hypoglycemia

- Ask at-risk patients about symptomatic and asymptomatic hypoglycemia at each encounter (C)
- Glucose* (15–20 g) preferred treatment for conscious individual with hypoglycemia (E) RULE OF 15
  - Repeat 15 minutes after initial treatment if hypoglycemia continues (per SMBG)
  - If SMBG is normal: consume meal or snack to prevent recurrence
- ADA Recommendations: Hypoglycemia (con't)
  - Hypoglycemia unawareness or one or more episodes of severe hypoglycemia should trigger re-evaluation of the treatment regimen (E)
  - Insulin-treated patients with hypoglycemia unawareness or an episode of severe hypoglycemia
    - Advised to raise glycemic targets to strictly avoid further hypoglycemia for at least several weeks, to partially reverse hypoglycemia unawareness, and to reduce risk of future episodes (A)

ADA Recommendations: Hypoglycemia (cont’d)

- Glucagon should be prescribed for all individuals at increased risk of severe hypoglycemia and caregivers/family members instructed in administration (E)
- Severe hypoglycemia should be treated using emergency glucagon kits
  - Those in close contact with, or having custodial care of, people with hypoglycemia-prone diabetes should be instructed in use of such kits.
  - Glucagon is ineffective in glycogen-depleted individuals and may also stimulate insulin release → less useful in T2DM

Case Study

- Mr. L’s Follow-up Visit:
  - Six months ago, he found he no longer had good glucose control
  - A1C: 9.4%, FBG 198 mg/dL and PPBG 365 mg/dL
  - His medications were changed to metformin 1000 mg BID, glimepiride 2 mg once daily, and basal insulin 20 units at HS
  - His FBG is 65 to 160 mg/dL and PPBG 100-245 mg/dL
  - He did not feel his low when he came in from doing yard work
What is your guidance for Mr. L?
1) Have him monitor his glucose fasting and 2 hours after one meal a day for the next week
1) Stop the glimepiride
2) Lower the basal insulin by 5 units
3) Schedule a diagnostic continuous glucose sensor
4) Increase his glucose targets to 100 mg/dl to 180 mg/dl

Steps to reduce hypoglycemia
• Re-evaluate and personalize glycemic goals
  – not everyone should have A1C <7%
• Educate patient on when to anticipate, how to recognize hypoglycemia, how to avoid hypoglycemia, and appropriate treatment of hypoglycemia
• Review insulin/secretagogue regimen, especially with respect to timing of administration and selection of dose
• Hypoglycemia questionnaire for patients

Prevention of Hypoglycemia

Patient Education/Monitoring
Understand and have knowledge of:

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Treatment</th>
<th>Peak times for insulin (or oral agent action)</th>
<th>Home glucose monitoring</th>
</tr>
</thead>
</table>

Self-monitoring of blood glucose ( SMBG)
Continuous glucose monitoring

Steps to prevent hypoglycemia
• Follow food and Rx plan
• Anticipate situations that trigger lows and take steps to prevent
• Test blood glucose regularly
  – Always check prior to driving if unawareness
• Carry carbohydrate
• Wear medical identification

Dietary/Exercise/Medication Interventions

Food related strategies
- Eat more consistently with respect to timing and portion sizes
- Avoid high carbohydrate snacks

Medication related strategies
- Switch to medication with lower risk of hypoglycemia
- Check blood glucose levels before and after exercise
- EAT if blood glucose <100 mg/dl

Activity related strategies
- Check blood glucose levels before and after exercise
- EAT if blood glucose <100 mg/dl

Helpful Resources
Provider Reminder Checklist to reduce hypoglycemia

Table 3—Hypoglycemia Provider Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remind the Hypoglycemia Patient: Questionnaire</td>
</tr>
<tr>
<td>2</td>
<td>Question the patient: circumstances surrounding previous or recent hypoglycemia</td>
</tr>
<tr>
<td>3</td>
<td>Discuss changes in blood glucose levels with the patient</td>
</tr>
<tr>
<td>4</td>
<td>Check medication changes where clinically appropriate</td>
</tr>
<tr>
<td>5</td>
<td>Recommend carrying quick acting/short-acting carbohydrates and/or continuous glucose monitoring system (CGMS) when patient is instructed to do so</td>
</tr>
<tr>
<td>6</td>
<td>Prescribe oral medications and/or insulin</td>
</tr>
<tr>
<td>7</td>
<td>Prescribe glargine if appropriate</td>
</tr>
</tbody>
</table>


Individual Assessment Checklist

A comprehensive approach to diabetes management should include periodic assessment of patient capabilities, strategies, and support systems. The Individual Assessment Checklist is a tool designed to facilitate discussion and evaluation of these aspects of care. It is intended to complement the Self-Assessment Checklist and to guide the diabetes team in identifying educational and support needs of the patient.

International Hypoglycemia Study Group (IHSG)

Diabetes Self-Management Education and Support

- CDE
- Dietitian
- Behaviorist
- AADE/ADA recognized programs
- Local patient support groups
- Online patient groups

Thank You!

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