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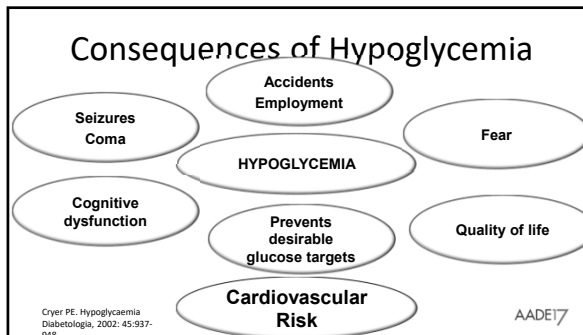
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 - Please refer to learning goals and objectives
 - Learners must attend the full activity and complete the evaluation in order to claim continuing education credit/hours
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Assessment, Treatment, and Prevention of Hypoglycemia in Diabetes

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- ### 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
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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.

7

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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



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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

9

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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

10

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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?

11

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Assessment of Hypoglycemia

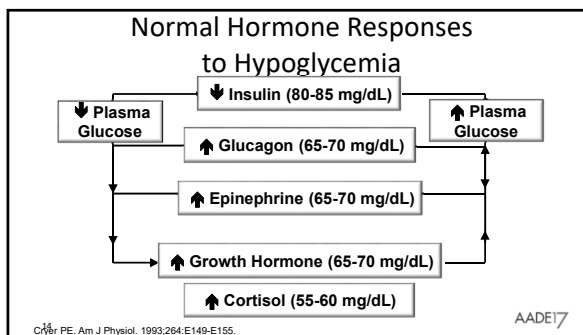
- **Does the individual have symptoms?**
 - **At what level does the individual feel low?**
 - **Do they monitor their blood glucose level?**

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Clinical Manifestations of Hypoglycemia

Autonomic	Neuroglycopenic
<ul style="list-style-type: none"> • Sweating • Tachycardia • Anxiety/Arousal • Widened pulse-pressure • Paresthesia • Tremulousness • Palpitations 	<ul style="list-style-type: none"> • Dizziness • Hypothermia • Headache • Cognitive Dysfunction • Behavioral changes • Confusion • Coma • Seizure • Death

13 Tower DA, Havlin, C. Craft S et al Diabetes, 1993;42:1791-1798



ADA Classification of Hypoglycemia in Diabetes

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

1 ADA Standards of Medical Care in Diabetes—Glycemic Targets. Diabetes Care 2017;40(Suppl. 1):S49-S56. 2 International Hypoglycemia Study Group. Diabetes Care. 2016

- ### Assessment of Hypoglycemia
- 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 glycemic therapy *per se* (lower HbA_{1c} levels, lower glycemic 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

Assessment of Hypoglycemia

- Does the individual have symptoms?
- **What were the precipitating factors?**

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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)

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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
 - Visual defects-incorrect dosing
 - Injections sites (IM vs subq, hypertrophied sites)
 - Intentional overdose
 - Memory, distractions
 - Double dose, wrong insulin
 - Injecting after the meal or too long before the meal-insulin timing
 - Exogenous glucose delivery is decreased (e.g. after missed meals and during the overnight fast)
 - Miscalculated carbs or meal size, lack of carbs in a meal

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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 ²
- Not recommended for glycemic management of hospitalized patients (at this time)³

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Medication Risk of Hypoglycemia By Class

- **More risk**
 - Insulin
 - sulfonylureas
- **Less risk**
 - Metformin
 - GLP-1 agonist
 - SGLT-2 inhibitors
 - DPP-IV inhibitors

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Hypoglycemia in Persons with Diabetes ≥ 65 Years

Risk factors for hypoglycemia in the elderly

Use of insulin or insulin secretagogues	Duration of diabetes	Antecedent hypoglycemia	Erratic meals	Renal insufficiency
Hospital discharge within the prior 30 days	Advanced age	Black race	Poly-pharmacy (≥ 5 concomitant medications)	

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Slide 22

EG8 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?**

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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
 - * Any form of glucose-containing carbohydrate can be used
 - SMBG=self-monitoring of blood glucose

American Diabetes Association Standards of Medical Care in Diabetes. Glycemic Targets. Diabetes Care 2017;40(Suppl. 1):S64-S74. AADE17


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)

American Diabetes Association Standards of Medical Care in Diabetes. Glycemic Targets. Diabetes Care 2017;40(Suppl. 1):S64-S74. AADE17

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



American Diabetes Association Standards of Medical Care in Diabetes. Glycemic Targets. Diabetes Care 2017;40(Suppl. 1):S64-S74. AADE17

Assessment of Hypoglycemia

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

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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

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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

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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



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Prevention of Hypoglycemia

Patient Education/Monitoring

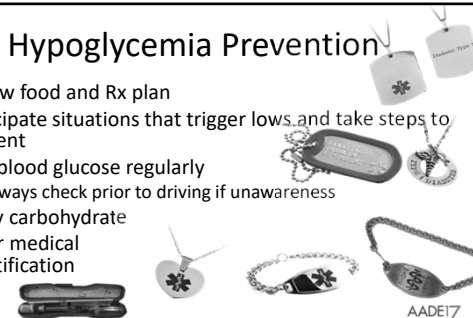
Understand and have knowledge of:

Symptoms	Treatment	Peak times for insulin (or oral agent action)	Home glucose monitoring
			Self-monitoring of blood glucose (SMBG) Continuous glucose monitoring

33 Sequist ER, et al. Diabetes Care. 2013;36:1384-1495. AADEI7

Hypoglycemia Prevention

- 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



Adapted from: Sequist ER, et al. Diabetes Care. 2013;36:1384-1495. AADEI7

Dietary/Exercise/Medication Interventions

Food related strategies	Medication related strategies	Activity related strategies
<ul style="list-style-type: none"> Eat more consistently with respect to timing and portion sizes Avoid high carbohydrate snacks 	<ul style="list-style-type: none"> Switch to medication with lower risk of hypoglycemia Would start with long acting analog if patient agrees to eat more consistently or consider developing a basal/bolus regimen Stop sulfonylurea and change the HbA1c target 	<ul style="list-style-type: none"> Check blood glucose levels before and after exercise EAT if blood glucose <100mg/dL

35 Sequist ER, et al. Diabetes Care. 2013;36:1384-1495. AADEI7

Helpful Resources

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Provider Reminder Checklist to reduce hypoglycemia

Table 3—Hypoglycemia Provider Checklist

Name _____
 First _____ Middle _____ Last _____
 Today's date _____

1. Reviewed the Hypoglycemia Patient Questionnaire
2. Questioned the patient about circumstances surrounding severe or moderate hypoglycemia
3. Discussed strategies to avoid hypoglycemia with the patient
4. Made medication changes where clinically appropriate
5. Recommended carrying snack and/or glucose tablets where appropriate and provided instructions for how to use them (take 15 g glucose, wait 15 min, and remeasure blood glucose; repeat if hypoglycemia persists). A 1-page patient handout on treating hypoglycemia is available at <http://clinical.diabetesjournals.org/content/30/1/38>
6. Prescribed glucagon if appropriate

Sequist ER, et al. Diabetes Care. 2013;36:1384-1405.

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Individual Assessment Checklist

Name _____ First _____ Middle _____ Last _____
 Today's date _____

1. The patient cannot open your left or right eye when you cover the other eye to test visual acuity.
2. The patient cannot see your left or right eye when you cover the other eye to test visual acuity.
3. The patient cannot see your left or right eye when you cover the other eye to test visual acuity.
4. The patient cannot see your left or right eye when you cover the other eye to test visual acuity.
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19. The patient cannot see your left or right eye when you cover the other eye to test visual acuity.
20. The patient cannot see your left or right eye when you cover the other eye to test visual acuity.

Sequist et al Diabetes Care, 2013

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International Hypoglycemia Study Group (IHSG)

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Diabetes Self-Management Education and Support

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



40

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Thank You!

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41

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