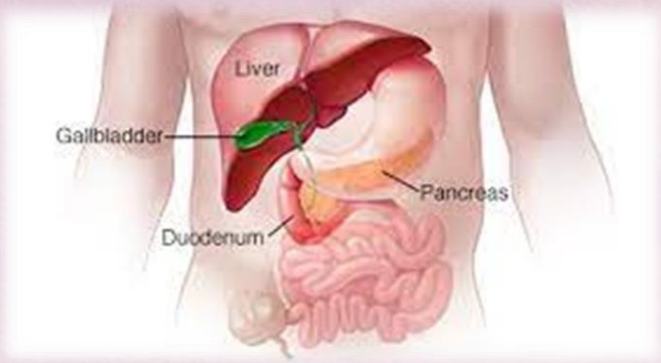
Introduction to Clinical Pharmacology

Chapter 40
Antidiabetic Drugs

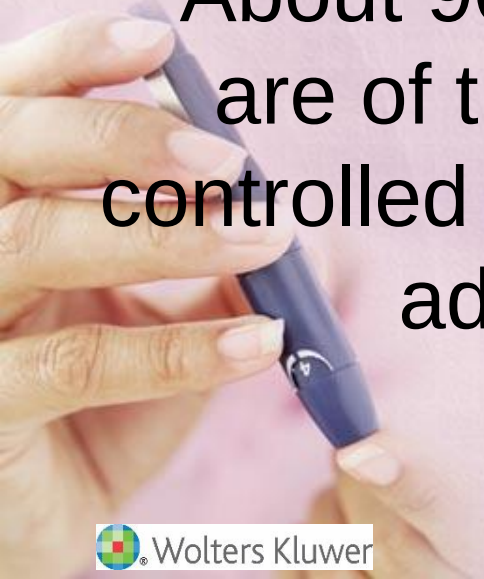
Insulin

- Hormone manufactured by beta cells of pancreas
- Controls the storage and utilization of amino acids and fatty acids
- Lowers blood glucose levels by inhibiting glucose production by liver



Diabetes

- Diabetes mellitus is a chronic condition in which insufficient insulin is produced by the pancreatic beta cells (type 1) or in addition to less insulin produced the body cells become resistant to insulin (type 2)
- About 90% to 95% of the cases of diabetes are of the type 2 variety; many of these are controlled with diet, exercise, and possibly the addition of an oral hypoglycemic drug



3 P’s

- Polydipsia: Excessive thirst
- Polyphagia: Eating large amounts of food
- Polyuria: Increased urination
- KNOWN AS CARDINAL SYMPTOMS

Risk Factors Type 2 Diabetes

- Obesity
- Older age
- Family history of diabetes
- History of gestational diabetes
- Impaired glucose tolerance
- Minimal or no physical activity
- Race/ethnicity (African Americans, Hispanic/Latino Americans, Native Americans, and some Asian Americans)

Insulin: Action and Uses

- Activates a process that helps glucose molecules enter the cells of striated muscle and adipose tissue
- Promotes protein synthesis
- Properties of insulin: onset, peak, duration
- Controls type 1 diabetes mellitus, type 2 diabetes, severe diabetic ketoacidosis
- Treats hypokalemia in combination with glucose

Insulin: Adverse Reactions, Contraindications, and Precautions

- Adverse reactions:
  - Hypoglycemia; hyperglycemia; allergic reaction
- Contraindicated in patients:
  - With hypersensitivity, hypoglycemia
- Used cautiously in patients:
  - With renal and hepatic impairment; during pregnancy and lactation

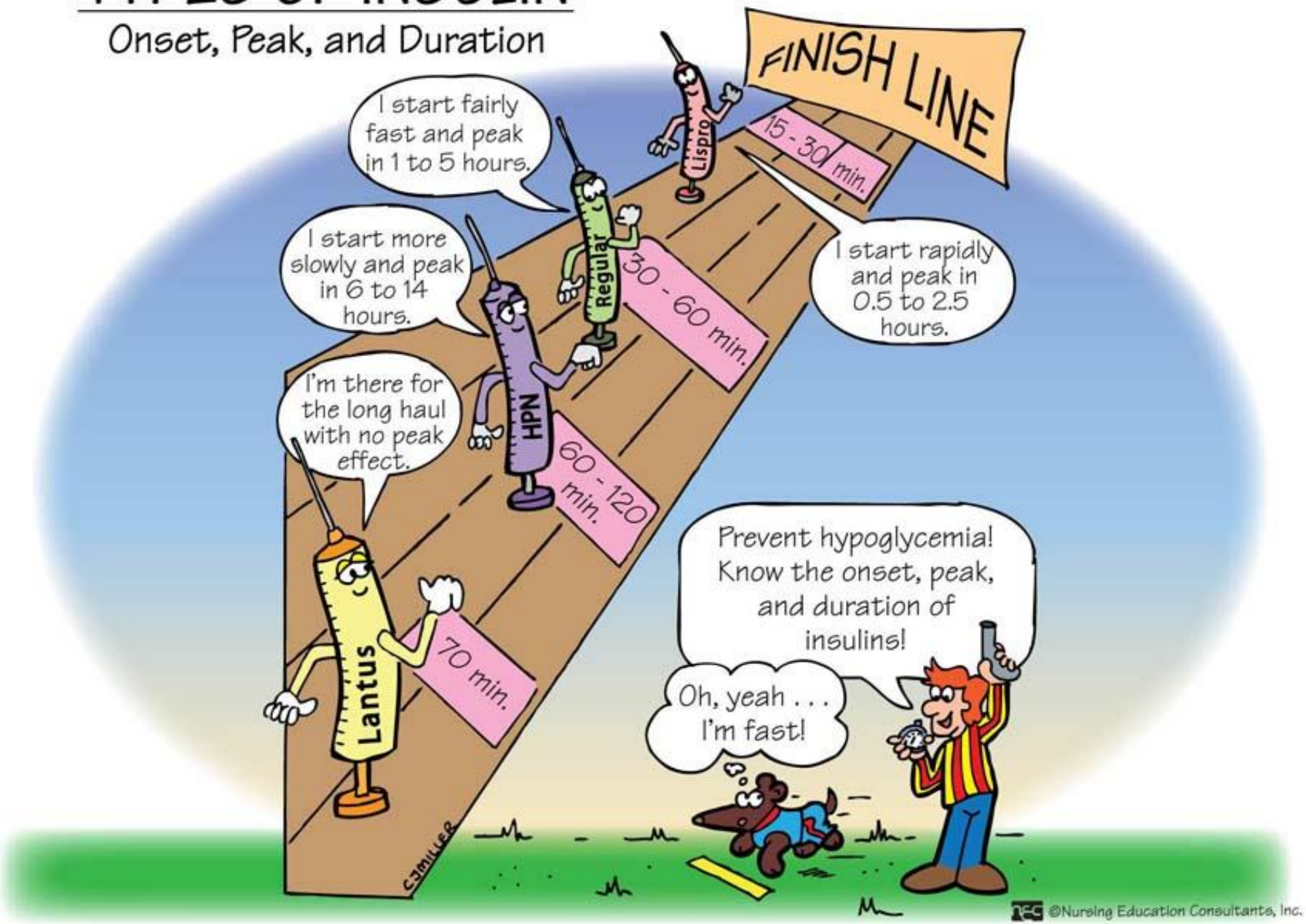
IMPORTANT TO KNOW

Main types of insulin preparations

Type	Onset	Peak	Duration	Comments
Rapid-acting insulin analogue	5-15 min	30-60 min	2-5 hr	Can be injected at the start of a meal
Short-acting (soluble/regular insulin)	30 min	1-3 hr	4-8 hr	Usually injected 15-30 minutes before a meal. Clear solution
Intermediate or long-acting insulin (isophane or zinc insulin)	1-2 hr (NPH, Lente) 2-3 hr (Ultralente)	4-8 hr 4-8 hr	8-12 hr (NPH) 8-24 hr (Ultralente)	Used to control glucose levels between meals. May be combined with short-acting insulin
Long-acting insulin analogue	30-60 min	No peak	16-24 hr	Usually taken once daily

TYPES OF INSULIN

Onset, Peak, and Duration



Short and Rapid-Acting Insulins

Insulin	Onset	Peak	Max Duration
Short-Acting			
Regular Humulin/Novolin R	30-60 min	2-3 hours	6-8 hours
Rapid-Acting			
Lispro (Humalog U-100;U-200) Aspart (Novolog or Fiasp) Glulisine (Apidra)	5-15 min; Fiasp: 2.5 min	1-2 hours	4-6 hours
Technosphere Insulin Afrezza	~12 min (measured effect)	35-45 min	~ 1 ½ to 3 hours

IMPORTANT TO KNOW

Nursing Process: Assessment #1

- Preadministration assessment:
  - Make general assessment of skin, mucous membranes, and extremities, with attention given to any sores or cuts and any ulcerations or other skin or mucous membrane changes
  - Include in patient's chart:
    - Dietary habits, family history of diabetes, type and duration of symptoms experienced

Nursing Process: Assessment #2

- Preadministration assessment (cont.)
  - Document type and dosage of insulin, if used; type of diabetic diet; average results of glucose in the patient's chart
  - Evaluate patient's past compliance with prescribed therapeutic regimen by health care provider

Nursing Process: Assessment #3

- Ongoing assessment:
  - Assess for signs and symptoms of hypoglycemia and hyperglycemia throughout insulin therapy
  - Administer supplemental insulin based on blood glucose readings and amount of insulin prescribed by health care provider in sliding scale
  - Notify health care provider if blood glucose level is greater than 400 mg/dL

BLOOD SUGAR MNEMONIC

HOT & DRY = SUGAR HIGH

COLD & CLAMMY =
NEED SOME CANDY

Nursing Process: Planning

- Expected outcomes:
  - Optimal response to therapy
  - Patient needs related to management of adverse reactions
  - Reduction in anxiety and fear
  - Improved ability to cope with the diagnosis
  - Understanding of and compliance with prescribed therapeutic regimen

Nursing Process: Implementation #1

- Promoting an optimal response to therapy
  - Administer insulin; care must be taken to use correct insulin
  - Carefully read all drug labels before preparing any insulin preparation
  - Read label of the insulin bottle carefully for name, source of insulin, number of units per milliliter

Nursing Process: Implementation #2

- Promoting an optimal response to therapy (cont.)
  - Mixing insulins:
    - Clarify with primary health care provider the type of insulin the patient is to receive
    - Ask whether insulins were given separately or together if patient had been using insulin mixtures before admission

Nursing Process: Implementation #3

- Promoting an optimal response to therapy (cont.)
  - Preparing insulin for administration:
    - Check expiration date printed on label of insulin bottle before withdrawing insulin
    - Gently rotate vial between palms of hands and tilt it gently end to end before withdrawing insulin
    - Check the prescribed order for type and dosage of insulin before withdrawing insulin from vial

Nursing Process: Implementation #4

- Promoting an optimal response to therapy (cont.)
  - Rotating injection sites: –
    - Carefully plan injection site rotation pattern; write plan in patient's chart
    - After giving injection, record site used; note any inflammation or skin reactions
    - Report localized allergic reactions, signs of inflammation, other skin changes to health care provider

Nursing Process: Implementation #5

- Promoting an optimal response to therapy (cont.)
  - Methods of administering insulin:
    - Disposable needle and special syringe
    - Insulin pump

Nursing Process: Implementation #6

- Promoting an optimal response to therapy (cont.)
  - Blood and urine testing:
    - Obtain blood glucose levels during hospitalization; teach patient to monitor blood glucose levels after discharge from acute care setting
    - Use second voided specimen to check glucose or acetone levels if urine testing is done

Nursing Process: Implementation #7

- Monitoring and managing patient needs
  - Acute confusion:
    - Never give oral fluids or substances used to terminate hypoglycemic reaction to patient unless swallowing and gag reflexes are present
    - Monitor for signs of any hypoglycemic reaction and report if signs are present

Nursing Process: Implementation #8

- Monitoring and managing patient needs (cont.)
  - Deficient fluid volume:
    - Treat diabetic ketoacidosis with fluids, correction of acidosis and hypotension, low doses of regular insulin
  - Anxiety:
    - Implement effective teaching program

Nursing Process: Implementation #9

- Assisting the patient with impaired adjustment, coping, and altered health maintenance:

Help patient gradually accept the – diagnosis and begin to understand the feelings

Nursing Process: Implementation #10

- Educating the patient and family:
  - Explain the importance of blood glucose or urine testing and the necessity of taking the drug as directed
  - Educate on the storage of insulin and purchase of needle and syringe
  - Explain the preparation of insulin administration
  - Emphasize and explain the recommended diet

Nursing Process: Evaluation #1

- Therapeutic effect is achieved; normal or near-normal blood glucose levels are maintained
- Adverse reactions are identified, reported, and managed successfully
- Anxiety and fear are reduced
- Patient demonstrates beginning ability to cope with disorder and its required treatment

Nursing Process: Evaluation #2

- Patient demonstrates positive outlook and adjustment to diagnosis
- Patient verbalizes willingness to comply with prescribed therapeutic regimen
- Patient demonstrates understanding of drug regimen
- Patient is able to test blood glucose levels using glucometer
- Patient administers insulin correctly

Oral Antidiabetic Drugs

- Used to treat patients with type 2 diabetes that is not controlled by diet and exercise alone
- Not effective for treating type 1 diabetes
- Types of oral antidiabetic drugs:

Sulfonylureas, biguanides, alpha (α)-–glucosidase inhibitors, meglitinides, thiazolidinediones

Biguanides

- Sensitizes the liver to circulating insulin levels, reduces intestinal glucose absorption, and reduces hepatic glucose production

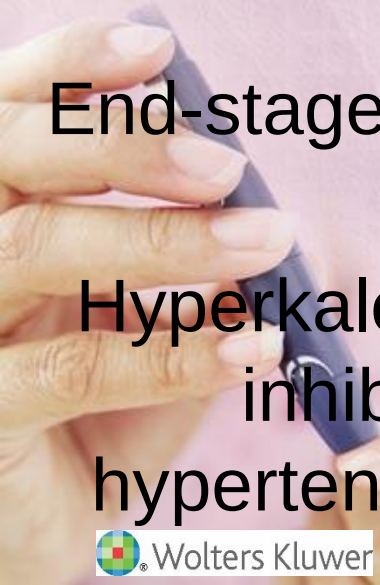
- Metformin-used in DM 2 initially, monotherapy
- Nausea, vomiting, diarrhea, and increased flatulence
- contrast medium is used-stop the day of and 48 hours after
- Discontinued for surgical procedures

Glucagon-like Peptide-1 Agonists

- Incretin hormones-increase insulin release and decrease glucagon levels
- Stimulates insulin release when a person eats and reduces glucagon and slows gastric emptying
- Trulicity, Byetta both used in DM 2
- Adverse reactions diarrhea, nausea and vomiting, and heartburn

Sodium-Glucose Linked Transporter-2 Inhibitors

- Glucose is reabsorbed in the kidney these drugs inhibit this process
- Glucose threshold is lowered allowing more glucose to leave the body via urine
- Will experience a drop in the HbA1c, weight, and systolic blood pressure and possible reduction in LDL
- End-stage kidney disease or those on dialysis should not take these
- Hyperkalemia is more likely to happen if taking ACE inhibitors, angiotensin II receptor blockers (both hypertension drugs), or potassium-sparing diuretics



Dipeptidyl Peptidase-4 Inhibitors

- Also called gliptins-lower the blood glucose level in those with type 2 diabetes by enhancing the secretion of the incretin hormone produced by the body
- Reduces glucagon and lowers blood glucose levels
- Headache and upper respiratory tract symptoms
- (sitagliptin)-Januvia

Thiazolidinediones

- Improve insulin sensitivity in muscle and fat cells and inhibit gluconeogenesis
- reducing insulin resistance in the cell and the HbA1c significantly lowers
- (rosiglitazone) Actos and (pioglitazone) Avandia

Alpha-Glucosidase Inhibitors

- Prevent the after-meal surge in blood glucose by delaying the digestion absorption of carbohydrates

Amylinomimetic

- Mimics the endogenous amylin effects by delaying gastric emptying, decreasing glucagon release, and decreasing appetite.
- Reducing blood glucose (HbA1c levels) and can help reduce weight

Sulfonylureas

- Appear to lower blood glucose by stimulating the beta cells of the pancreas to release insulin
- Most commonly used sulfonylureas are the second- and third-generation drugs, such as glimepiride (Amaryl), glipizide (Glucotrol), and glyburide (DiaBeta)
- first-generation sulfonylureas rarely used today

Meglitinides

- Like the sulfonylureas, they act to lower blood glucose levels by stimulating the release of insulin from the pancreas
- Act more rapid than sulfonylureas but shorter duration much shorter

Nursing Process: Assessment #4

- Preadministration assessment:
  - Assess weight, blood pressure, pulse, respiratory rate
  - Assess skin, mucous membranes, and extremities, with special attention given to sores or cuts that appear to be healing poorly and ulcerations or other skin or mucous membrane changes

Nursing Process: Assessment #5

- Ongoing assessment:
  - Monitor vital signs; observe adverse drug reactions
  - Notify primary health care provider if adverse reaction occurs or if there is significant weight gain or loss

Nursing Process: Diagnosis

- **Acute Confusion** related to hypoglycemia effects on mentation
- **Deficient Fluid Volume** related to fluid loss during DKA
- **Anxiety** related to uncertainty of diagnosis, testing own glucose levels, self-injection, dietary restrictions, other factors (specify)
- **Ineffective Breathing Pattern** related to hyperventilation in lactic acidosis with metformin use

Nursing Process: Planning #1

- Expected outcomes:
  - Optimal response to therapy
  - Support of patient needs related to management of adverse reactions
  - Reduction in anxiety
  - Improved ability in coping with diagnosis
  - Understanding of and compliance with prescribed therapeutic regimen

Nursing Process: Implementation #11

- Promoting an optimal response to therapy
  - Sulfonylureas: give glipizide 30 minutes before meal due to food delays
  - α-Glucosidase inhibitors: monitor response to drugs by periodic testing
  - Biguanides: administer metformin two or three times a day with meals
  - Meglitinides: give repaglinide 15 minutes, up to 30 minutes, before meal
  - Thiazolidinediones: if dose missed at usual meal, take drug at the next meal

Nursing Process: Implementation #12

- Monitoring and managing patient needs
  - Acute confusion:
    - Immediately terminate hypoglycemic reaction
    - Notify primary health care provider if episodes of hypoglycemia occur
  - Deficient fluid volume:
    - Notify health care provider if blood glucose levels are elevated or if ketones are present in urine

Nursing Process: Implementation #13

- Monitoring and managing patient needs (cont.)
  - Anxiety:
    - Emphasize importance of following the prescribed treatment regimen
    - Encourage patient to talk about disorder, express concerns, ask questions
  - Ineffective breathing pattern:
    - Monitor patient for symptoms of lactic acidosis, unexplained hyperventilation, myalgia, malaise, GI symptoms, unusual somnolence

Nursing Process: Implementation #14

- Educating the patient and family:
  - Explain the importance of following the prescribed diet and drug regimen
  - Explain the importance of testing blood for glucose and urine for ketones
  - Emphasize maintaining good foot and skin care and routine eye and dental examinations

Nursing Process: Implementation #15

- Educating the patient and family (cont.):
  - Metformin: instruct patient to discontinue drug therapy; notify primary health care provider if any distress occurs
  - α-Glucosidase inhibitors: explain the importance of having ready source of glucose when taking the drug
  - Meglitinides: instruct patient not to take the drug if a meal is skipped

Nursing Process: Evaluation #3

- Therapeutic drug effect is achieved; normal or near-normal blood glucose levels are maintained
- Hypoglycemic reactions are identified, reported, and managed successfully
- Anxiety is reduced
- Patient begins to demonstrate ability to cope with disorder and its required treatment

Nursing Process: Evaluation #4

- Patient demonstrates positive outlook and adjustment to diagnosis
- Patient verbalizes willingness to comply with prescribed treatment regimen
- Patient demonstrates an understanding of the drug regimen
- Patient demonstrates understanding of the information presented in teaching sessions
- Patient is able to use glucometer correctly to monitor blood glucose levels or test urine for glucose and ketones