Hormones and Hormone Antagonists

Insulin:

2 main hormones are secreted from the pancreas:

1- Insulin which is secreted by β -cells of islets of Langerhans and stored in the pancreas (β -. cells) as a large protein known as **proinsulin.**

2- Glucagon is opposing the action of insulin. It is secreted by the -α cells of islets of Langerhans, it converts glycogen to glucose and elevates blood glucose level.

Diabetes Mellitus

❖ Type 1:

- Early onset
- Loss of pancreatic B cells → absolute dependence on insulin (diet + insulin± oral agents)
- Ketoacidosis-prone

❖ Type 2

- Usually adult onset
- ↓ response to insulin → (diet → oral hypoglycemics ± insulin)
- Not ketoacidosis prone.

Insulin Release

Increased by:

Glucose

Sulfonylureas

β2-agonists

Decreased by:

α2-agonists

Insulin:

1- Rapid- acting insulin.

a) Insulin injection (regular, crystalline zinc insulin) .

b) Prompt insulin zinc suspension.

2- Intermediate- acting insulin

a) Isophane insulin suspension (NPH)

b) Insulin zinc suspension (lente)

3- Long-acting insulin
a) Protamine zinc insulin suspension (PZI)
b) Extended insulin zinc suspension (ultralente)

Contraindications:

Hypersensitivity to insulin.

Insulin antagonists:

1- **Growth hormone elevates glucose level and decreases glycogen synthesis.**
2- **Glucocorticoids enhance conversion of protein to glucose.**
3- **Adrenaline decreases insulin release and enhance glycogenolysis.**
4- **Thyroid hormones promote gluconeogenesis.**

Glucagon Nursing considerations:

1- Read the product information and any important notes inserted into the package.
2- Refrigerate stock supply of insulin but avoid freezing.
3- Follow the guidelines with respect to mixing the various types of insulin.
4- Invert the vial several times to mix before the material is withdrawn “avoid vigorous shaking”.
5- Assist patients for self-administration of insulin.
6- Rotate the sites of S.C. injections to prevent the problem of hypertrophy or atrophy at injection site.
7- Allow insulin to remain at room temperature 1 hour before administration.
8- Apply pressure for 1 minute, don’t massage since it may interfere with rate of absorption.
9- If breakfast must be delayed, delay the administration of morning dose of insulin.
10- Obtain a thorough nursing history from the client / family.
11- If the client has symptoms of hyperglycemia reaction: - Have regular insulin available for administration. - Monitor client closely after administration. - Check blood glucose, urine glucose, and acetone.

Oral Antidiabetic (Hypoglycemic) Agents

Indication:

- Non- insulin dependent diabetes mellitus (NIDDM) (type II).
- Several oral antidiabetic agents are available for patients with noninsulin dependent diabetes.

Action of oral antidiabetic agents:

- **Increases the sensitivity of pancreatic islet cells.**
- **Increases insulin secretion by β -cells.**
- **The peripheral tissues become more sensitive to insulin due to an increase in the number of insulin receptors and increase the insulin ability to combine with receptors.**

1. Sulfonylureas

- Oral hypoglycemic agents are classified as either first or second generation. Generation refers to structural changes in the basic molecule.
- Second–generation oral hypoglycemic agents are more lipophilic and have greater hypoglycemic potency (200 times) than first generation.

Classification:

1- First – generation sulfonylureas compounds such as:

a) Tolbutamide (orinase).

b) Chlorpromide (diabenase).

c) Glibenclamide (Daonil).

2- Second-generation sulfonylureas compounds such as: - Glyburide (Micronase).

Mechanism of Action:

1. Bind to SUR1 receptor on pancreatic beta cells.
2. Block ATP-sensitive K^+ channels → causes membrane depolarization.
3. Open voltage-gated Ca^{2+} channels → calcium enters the cell.

4. Increase in intracellular Ca^{2+} triggers insulin release.
5. More insulin → lower blood glucose levels.

Side effects:

- Hypoglycemia (most common). - Nausea, heartburn, diarrhea - Headache, dizziness, general weakness. - Pancytopenia. - Chronic use increases risk of cardiovascular mortality. - Cholestatic jaundice (rare).

Nursing considerations:

- Drugs may be taken with food to minimize GI upset.
- Stop the medication if signs of side effects or ketoacidosis appear.

1- Chlorpromide
2- Tolbutamide
3- Glibenclamide
4- Glyburide:

2. Biguanides

Mechanism of Action:

Reduce hepatic glucose production by inhibiting gluconeogenesis, improve insulin sensitivity in peripheral tissues (muscle/fat), and enhance glucose uptake via AMPK activation.

Examples:

- Metformin (Glucophage)

3. DPP-4 Inhibitors

(Dipeptidyl Peptidase-4 Inhibitors)

Mechanism of Action:

Inhibit the DPP-4 enzyme → prolong incretin hormone action (GLP-1, GIP) → increase insulin secretion and suppress glucagon secretion in a glucose-dependent manner.

Examples:

- Sitagliptin
- Saxagliptin

- Linagliptin
- Alogliptin

4. SGLT2 Inhibitors

(Sodium-Glucose Co-Transporter 2 Inhibitors)

Mechanism of Action:

Block SGLT2 transporters in the renal proximal tubules → reduce glucose reabsorption in the kidneys → increase urinary glucose excretion → lower blood glucose levels.

Examples:

- Empagliflozin
- Dapagliflozin
- Canagliflozin

Insulin antagonist

Glucagon:

Class: Insulin antagonist.

Action:

It is a hormone produced by the alpha-islets cells of pancreas. It increases blood glucose by:

1- Breakdown of glycogen to glucose.

2- Stimulate gluconeogenesis from amino acids and fatty acids.

3- Inhibit conversion of glucose to glycogen.

Blood glucose within 5-20 minutes, Duration 1-2 hrs.

Uses: Hypoglycemic crisis.

Side effects: Nausea, vomiting, respiratory distress , hypotension

Nursing considerations:

- Once the hypoglycemic client is responded, supplemental CHO should be given to prevent secondary hypoglycemia.
- Administer with glucose solution (dextrose) not saline (precipitate may from) .

Posterior Pituitary Hormones

1-Methylergonovine Maleate:

Trade name: Methergine.
Class: Oxytocic agent.
Action: Is a synthetic agent stimulating the rate, tone and amplitude of uterine contractions. It also stimulates smooth muscles surrounding certain blood vessels by interacting with adrenergic and dopaminergic receptors.
Uses:
1- Management and prevention of postpartum and postpartum hemorrhage by producing firm contraction and decrease uterine bleeding.
2- Incomplete abortion.
Contraindications:
- Pregnancy
- Hypertension
- To induce labor
- Toxemia
- Prior to delivery of placenta

Side effects:
Nausea, vomiting, diarrhea, allergic reaction, Dizziness, headache, tinnitus.
N.B.: use of this substance during labor may result in uterine tetany with rupture, cervical laceration, embolism of amniotic fluid and intracranial hemorrhage in infant.

2-Oxytocin:

Trade name: Pitocin
Class: oxytocic agent.
Action:
- It has uterine stimulants, vasopressors and antidiuretic properties.
- Mimics uterine contractions of normal labor.

- Facilitates ejection of milk from the breasts by stimulating smooth muscles.

Uses:

- Antepartum induction or stimulation of labor.
- Uterine inertia (hypotonic contractions).
- For induction of labor in case of preeclampsia, eclampsia, maternal diabetes and other conditions.
- To hasten uterine involution.
- Intranasally for postpartum hemorrhage and uterine atony.

Contraindications:

- Hypersensitivity
- cephalopelvic disproportion (C.P.D.)
- Malpresentation
- undilated cervix
- History of cesarean delivery.

Side effects:

Tetanic uterine contraction, rupture uterus Hypertension, tachycardia.
To Fetus: - it may cause death, intracranial hemorrhage, brady or tachycardia

Nursing Considerations:

1- The physician should be available during administration of the drug.
2- Use Y-tubing for I.V. administration (one bottle contains oxytocin and another free).
3- Note any history of hypersensitivity and other contraindications.
4- Check for cervical dilation and uterine contractions patterns.
5- Remain with the client throughout the administration of medication.

6- Monitor fetal heart rate at least every 10 minutes.
7- Check vital signs every 15minutes.
8- Prevent uterine rupture and fetal damage by clamping off I.V. oxytocin, start medication – Free fluid , provide O2 and notify the physician in case of hypertonic uterine contraction and abnormal fetal heart rate patterns.

Antidiuretic hormone ADH

1-Vasopressin Tannate:
Trade name : Pitressin Tannate.
Class: Pituitary (antidiuretic hormone ADH).
Action:
The ADH (vasopressin), released from the posterior pituitary, regulates water conservation by promoting reabsorption of water by increasing the permeability of the collecting ducts of the kidney.
Uses: Neurogenic diabetes insipidus.
Contraindications:
- Angina pectoris
- chronic nephritis
Side effects:
Nausea, vomiting, increased intestinal activity leading to belching and
increased desire to defecate, allergic reaction, tremor, bronchoconstriction.
Nursing considerations:
1- Administer 1-2 glasses of water prior to use of medication to minimize side effects.
2- Warm the vial of vasopressin tannate in oil in hands and mix until the hormone is distributed throughout the solution before withdrawing the dose.
3- Note any history of vascular disease.

4- Monitor intake and output.
5- Check for signs of dehydration (thirst , skin turgor).
6-Weight the patient daily.

Thyroid Hormonal Drugs

1. Levothyroxine

Class: Synthetic thyroid hormone (T_4)
Indication:
- Primary hypothyroidism (e.g., Hashimoto's thyroiditis)
- Post-thyroidectomy
- Thyroid hormone replacement therapy

Mechanism of Action:
- Levothyroxine is converted in the body to T_3, the active form.
- T_3 binds to thyroid hormone receptors, modulating gene transcription.
- This leads to increased protein synthesis, basal metabolic rate, and oxygen consumption across multiple organ systems.

Side Effects
- Palpitations, insomnia, weight loss, heat intolerance
- Long-term high dose: bone loss, arrhythmias

Nursing Considerations:
- Give on an empty stomach, 30–60 minutes before breakfast
- Monitor TSH levels
- Avoid concurrent intake with calcium, iron, or antacids

Antithyroid Drugs

Methimazole & Propylthiouracil (PTU)
Class: Thioamide derivatives

Indications:

- Hyperthyroidism (e.g., Graves' disease)
- PTU is preferred in first trimester of pregnancy and thyroid storm

Mechanism of Action:

- Both drugs inhibit thyroid peroxidase enzyme, which blocks:
- Oxidation of iodide
- Iodination of tyrosine residues on thyroglobulin
- Coupling of iodotyrosines → prevents synthesis of T_3 and T_4
- PTU additionally inhibits peripheral conversion of T_4 to T_3

Adverse Effects:

- Agranulocytosis (rare but serious)
- Hepatotoxicity (more common with PTU)
- Rash, arthralgia

Nursing Considerations:

- Monitor CBC (for agranulocytosis) and liver function tests
- Educate patient to report signs of sore throat, fever
- PTU preferred in pregnancy; Methimazole is contraindicated in first trimester