Disorders of the endocrine system /Endocrinology

Diabetes Mellitus

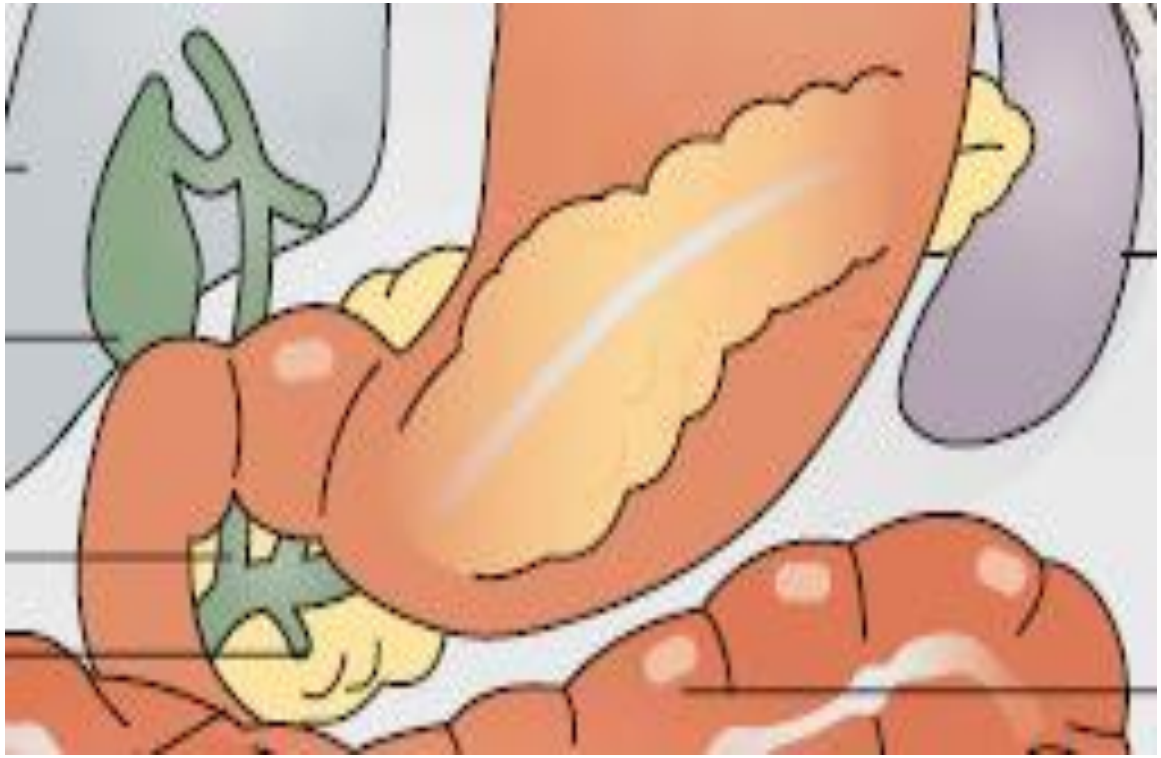
Anatomy and physiology

- The endocrine system has far-reaching effects in the human body.
- Because of its links with the nervous system and the immune system.
- The endocrine glands secrete their products directly in to the blood stream,
- Exocrine glands such as sweat glands secretes their products through ducts in to epithelial surface or into the GIT.

Pancreas

- Is a fish shaped organ
- Located in the upper abdomen behind & inferior to the liver & stomach.
- It has both endocrine & exocrine function
- Islets of langerhan's [the endocrine part of the pancreases] composed of:
  - Alpha cells which secret glucagon
  - Beta cells which secret insulin
  - Delta cells which secret somatostatin.
  - Gamma cells which secret pancreatic polypeptide.

Fig. pancreas



Cont---

- ***Insulin***
- Is one of the polypeptide hormones.
- It is a powerful hypoglycemic agent
- It acts to lower blood glucose level by promoting the passage of glucose in to cells.
- It is the only hormone in the body that decreases blood glucose level.
- Plays a key role in the metabolism of CHO, fat & protein
- It is an anabolic (storage) hormone.

Function of Insulin

- Stimulate the active transport of glucose in to muscle and liver.
- Enhances storage of dietary fat in adipose tissue.
- Regulate the rate at which CHO are used by the cells for energy.
- promotes conversion of glucose in to glycogen but inhibits the conversion of glycogen to glucose
- Promotes the conversion of fatty acids in to fat but inhibits break down of adipose tissue, mobilization of fat (fat to glucose) & conversion of fat in to ketone bodies.

Cont----

- Promote protein synthesis with in the tissues but inhibits the conversion of protein in to glucose.
- Accelerates transport of amino acids (derived from dietary protein) in to cells
- It also inhibits the breakdown of stored glucose, protein and fats.

Cont---

- During fasting periods (between meals and overnight) the pancreas continuously releases a small amount of insulin another pancreatic hormone called **glucagon** is release stored glucose.
- The insulin and the glucagons together maintain a constant level of glucose in the blood by stimulating the release of glucose form the liver.

Cont---

- Initially, the liver produces glucose through the breakdown of glycogen (***glycogenolysis***).
- After 8 to 12 hours with out food, the liver forms glucose from the breakdown of non carbohydrate substances, including amino acids ***(gluconeogensis***)

Cont---

- Antagonists of insulin.
- Epinephrine
- Corticosteroid
- Growth hormone
- Glucagon
- **Glucagon**
- Is a potent hyperglycemic agent which rises blood sugar by promoting the conversion of glycogen [the principal form in which CHO are stored] to glucose with in the liver.

Diabetes Mellitus (DM)

- **Definition**: is an endocrine disease characterized by metabolic abnormalities (Carbohydrate, fat, protein)
- Central feature is hyperglycemia due to absolute or relative insulin deficiency.
- It results from defects in insulin secretion, insulin action or both.

Types of DM

- There are several type of DM , but the major classifications are:

1) Type I, Insulin dependent DM (IDDM).
2) Type II, non-insulin dependent DM (NIDDM).
3) Gestational DM
4) DM associated with other factors

Etiology

- **Genetic** – especially there is a genetic correlation with NIDDM of identical twins.
- Linked to HLA in IDDM (20 x risk).
- **Environmental factors**
  - Obesity
  - Age
  - Protein energy malnutrition/ PEM
  - Infection (viral)- β- cell destruction.
  - Chemical burns
- **Auto immunity** - Type I

I) TYPE I DIABETES

- It is characterized by destruction of the pancreatic beta cells.
- It is thought that combined genetic, immunologic, and possibly environmental (ex. Viral) factors contribute to beta cell destruction.
- Genetic susceptibility is a common underlying factor in the development of type 1 diabetes.

Cont---

- People do not inherit type 1 diabetes itself; rather, they inherit a genetic predisposition, or tendency toward developing type 1 diabetes.
- This genetic tendency has been found in people with certain **HLA** (human Leukocyte antigen) types.
- HLA refers a cluster of genes responsible of transplantation antigens and other immune processes.

Cont---

- Immune –mediated diabetes commonly develops during childhood and adolescence.
- There is also evidence of an autoimmune response in type 1 diabetes.

Pathophysiology

- Pancreatic β-cells destroyed by auto immune process ⇨ ↓ (no) insulin production ⇨ unchecked glucose production by the liver ⇨ **hyperglycemia**
- Glucose delivered from food cannot be stored in the liver,
- Instead remain in the blood stream & contributes in **post prandal hyperglycemia**.
- **Fasting hyperglycemia** occurs as a result of unchecked glucose production by the liver.

Cont---

- Deficiency of insulin → glucose will not be conveyed from extra cellular to intracellular compartment → the cells become energy depleted → fat & protein will be drawn from adipose tissue & muscle & negative nitrogen balance and ketosis → increased appetite →**polyphagia**.
- Increased blood glucose level pulls cellular water in the blood → cellular dehydration → **polydepsia**

Cont---

- Increased BGL→ the kidneys may not reabsorb all the filtered glucose [blood exceeds the renal threshold for glucose usually 180 to 200 mg/dl]→ **glucosuria**→ decrease re-absorption of water by the renal tubules **polyuria**.
- When excess glucose is excreted in the urine, it is accompanied by excessive loss of fluids and electrolytes.
- This is called ***Osmosis diuresis.***

Cont---

- Insulin deficiency leads to glycogenolysis and gluconeogensis (production of new glucose from amino acids and other substrates) and contribute to **hyperglycemia.**
- In addition, fat breakdown occurs, resulting in an increased production of **Ketone bodies** which are the by products of fat breakdown

2- Type-II DM (NIDDM)

- The two main problems related to insulin in type -2 diabetes are:-
  - Insulin resistance (IR) and
  - Impaired insulin secretion
- IR refers to a decreased tissue sensitivity to insulin
- Normally, insulin binds to special receptors on cell surfaces and initiates a series of reactions involved in glucose metabolism.

Cont---

- Insulin resistance impairs glucose utilization by insulin sensitive tissues & increases hepatic glucose out put →**hyperglycemia**.

- The exact mechanisms that lead to this problem in type 2 diabetes are unknown, although genetic factors are thought to play a role.

Cont---

- It occur most commonly in people older than, 30years who are obese.
- Because it is associated with a slow (over years), progressive glucose intolerance,
- The onset of type 2 DM may go undetected for many years.

Cont---

- Despite the impaired insulin secretion that is characteristic of type 2 diabetes,
- There is enough insulin present to prevent the breakdown of fat and the accompanying production of ketone bodies.
- Therefore, DKA doesn't typically occur in type II DM .
- Uncontrolled type II DM may, lead to other acute problem, **HHNS** (Hyperglycemic Hyperosmolar non Ketotic Syndrome).

Clinical comparison of Type I & type II DM

Factors	*Type I*	*Type II*
▪ Synonymous	formerly known as juvenile onset DM / growth onset DM	Maturity onset DM
▪ Age of set	usually before the age of 30 but may occur at any age	Usually above 40 but may occur at any age
▪ Body habits	to wasted	Obese
▪ Acute complications	Diabetic Ketoacidosis (DKA)	Hyperglycemia Hyper osmolar non ketotic coma (HHNK)
▪ HLA association	Yes	No
▪ Therapeutic control with insulin	Yes	Yes /NO
▪ Concordance in identical twins	<50%	100%
▪ Possible etiology	absolute insulin deficiency	Relative insulin deficiency

3. Gestational DM

- Occurs in women who did not have diabetes before pregnancy.
- Is any degree of glucose intolerance with its onset during pregnancy.
- Hyperglycemia develops during pregnancy because of the secretion of placental hormones, which causes insulin resistance
- Insulin resistance related to the metabolic changes of late pregnancy increase insulin requirements.

Cont---

- After delivery blood glucose levels return to normal ,
- However, many women (30- 40%) who have had gestational DM may develop type 2 diabetes later in life.
- Therefore all must be counseled to maintain their ideal body weight and to exercise regularly to reduce their risk for type 2 diabetes.

4. DM associated with other medical conditions

- Accompanied by conditions known or suspected to cause the disease.
- Pancreatic disease.
- Hormonal abnormalities.
- Drugs such as glucocorticosteroids, thiazide diuretics , estrogen containing preparations.

CLINICAL MANIFESTATIONS

- "Three Ps" (3P's) ± weight loss
  - Polyuria
  - Polydipsia and
  - Polyphagia
- Increased urination and thirst occur as a result of the excess loss fluid associated with osmotic diuretics.
- The patients also experience increased appetite resulting from the catabolic state induced by insulin deficiency and the breakdown of proteins and fats.

Cont---

- Other symptoms include
  - Fatigue and weakness
  - Sudden vision changes
  - Tingling or numbness in hands or feet
  - Dry skin
  - Skin lesions or wounds that are slow to heal and
  - Recurrent infections

Diagnostic evaluation

- IDDM is diagnosed on the presence of the 4 cardinal symptoms;
- i.e. **3 P's - weight** and lab findings [glucosuria, hyperglycemia, ketoneuria, and acidosis]
- The two major diagnostic tests for diabetes are blood & urine

A) **Blood Tests**

1. Fasting blood sugar (FBS)
2. Random Blood sugar(RBS)
3. Oral Glucose tolerance test (OGTT)

Cont---

- ***Fasting Blood sugar (FBS)***
- Determines the amount of glucose in the blood when the patient is fasting.
- Blood is drawn & sent to lab.
- FBS ≥126 mg/dL .
- Fasting is defined as no caloric intake for at least 8 hours.
- **Random blood sugar (RBS)**
- Normal <200mg/dl abnormal >200mg/dl

Cont---

- **Oral glucose tolerance test (OGTS)**
- Two-hour postload glucose ≥200 mg/dL during an oral glucose tolerance test.
- The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.
- The third measure is not recommended for routine clinical use.

Cont---

- **WHO Diagnostic criteria for DM in non- pregnant Adults**

- RBS ≥200mg/dl [11.1mmol/L] 1mmol/L = 18 mg/dl
- FBS ≥126mg/dl
- OGTT ≥200 mg/dl on two occasions

Cont---

B) Urine tests

- Applying urine to a reagent strip or tablet matching colors on strip with a color chart at the end of specified time.
- It is cheap and easily diagnostic method.
- Not specific for glucose (lactose in pregnancy gives false +ve result)
- Does not indicate hypoglycemia

DIABETES MANAGEMENT

- **The aim of Rx of DM**
- To control the patients symptoms & maintain a sense of well being
- To normalize insulin activity and achieve normal blood glucose level(euglycemia) with out hypoglycemia
- To maintain normal weight in adult & normal growth & development in children
- To prevent acute metabolic complications such as ketoacidosis, hypoglycemia.
- To prevent the long-term complications of DM.

Cont--

- There are 5 components of diabetic management
- Dietary [nutritional Management]
- Exercise
- Medication [Pharmacologic therapy]
- Education and
- Monitoring [follow up]

A) Dietary Management

- **Aim**
- To control total calorie intake
- To attain /maintain a reasonable body weight
- To control blood glucose levels

Cont---

- Nutritional, diet and weight control are the foundation of diabetes management
- For obese diabetic patients (especially those with type 2 diabetes), wt loss is the key to Rx

Cont---

- Long term adherence to the meal plan is one of the most challenging aspects of diabetes management
- For all pts with diabetes, the meal plan must consider the pt's;
  - Food preference,
  - Lifestyle,
  - Usual eating times &
  - ethnic & cultural backgrounds.

Principles of Diabetic Dietary therapy

1) Food intake must be spread evenly through out the walking hours and taken at regular times in relation to insulin dose.
2) The diet must be balanced in relation to fat protein & CHO
3) Approximately the same amount of food should be eaten every day.
4) Diet should be based on the ordinary foods used by the family.
5) The obese diabetic must restrict food intake & lose weight if diabetic control is to be achieved

Cont---

- N.B. Several decades ago, it was recommended that diabetic diets contain more calories from proteins & fats foods than from carbohydrates to reduce postprandial increases in blood glucose levels.
- However, this resulted in a dietary intake inconsistent with the goal of reducing the cardiovascular disease commonly associated with diabetes.

Cont----

- The caloric distribution currently recommended is higher in carbohydrates than in fat & protein.
- Currently the American Diabetic Association (ADA), recommend that for all levels of caloric intake,
- 50% to 60% of calories should be derived from carbohydrates,
- 20% to 30% from fat, & the remaining 10% to 20% from protein.

General dietary Instructions

- Foods which the diabetic should avoid (i.e. rapidly absorbed CHO)
  - Sugar , honey, candy
  - cakes, sweet biscuits
  - Soft drinks, and alcohol [tej, whisky, areki--]

Cont---

- Food allowed in moderation (shouldn't be eaten in excess amount)
  - Foods from grain e.g enjera, bread, kinche, kita, porridge, atmite
  - Foods from peas, beans & chick peas
  - Potato , sweat potatoes, kocho
  - All fruit except lemon & grape fruit
  - Macaroni, pasta etc.

Cont---

- Foods freely allowed or with minimal restriction
- Lean meat &fish
- Eggs , cheese, milk
- Green or leafy vegetables
- Lemon & grape fruit
- Tea, coffee, with out sugar
- Mineral water
- Spices, pepper, berbere , garlic etc.

Exercise

- **Aim**:
- To reduce the blood glucose level
- To improve insulin utilization
- To improve circulation & muscle tone as well as to decrease weight

Exercise cont---

- Exercise lowers blood glucose & reduce cardiovascular risk factors.
- It lowers the BGL by increasing the uptake of glucose by body muscles & by improving insulin utilization
- It also improves circulation and muscle tone.
- Regular daily exercise rather than sporadic exercise should be encouraged

Exercise cont---

- Unplanned exercise can course a dangerous hypoglycemic reaction
- N.B. gradual increase in length of the exercise period is encourage with patients with DM.

Exercise precautions

- Patients who have_BGL exceeding 250mg/dl and who have ketones in their urine should not begin exercising until the urine test becomes –ve for ketone;
- Otherwise, the BGL increases the secretion of glucagon, GH and catecholamine.
- The liver then releases more glucose, & the result will elevate BGL rather than lowering.

Exercise precautions cont---

- Another potential problem for patients who take insulin is hypoglycemia that occurs many hours after exercise.
- To avoid post exercise hypoglycemia, especially after strenuous or prolonged exercise,
- The patient may need to eat a snack at the end of the exercise session and
- At bed time and monitor the blood glucose level more frequently.

Cont---

- **General precautions for exercise**
  - Use proper footwear and, if appropriate, other protective equipment
  - Avoid exercise in extreme heat or cold env't
  - Inspect feet after exercise
  - Avoid exercise during periods of poor metabolic control

Cont----

- **<u>Exercise recommendations</u>**
  - People with diabetes should exercise;
  - At the same time (preferably when blood glucose levels are at their peak) and
  - In the same amount each day
  - Regular daily exercise, rather than sporadic exercise should be encouraged
  - In general, a slow, gradual increase in the exercise periods is encouraged

Monitoring Glucose levels

- Blood glucose monitoring is cornerstone of diabetes management, and
- **Self Monitoring of blood glucose (SMBG)** levels by patients has dramatically altered diabetes care.
- This allows for detection and prevention of hypoglycemia and hyperglycemia and
- plays a crucial role in normalizing blood glucose levels, which in turn may reduce the risk of long-term diabetes complication.

Cont----

- Various SMBG methods are available.
- Most involve obtaining a drop of blood from fingertip, applying the blood to a special reagent strip, and
- Allowing the blood to stay on the strip for seconds and finally the meter gives a digital readout of the blood glucose value.

Pharmacologic therapy

- ***Insulin therapy***
- In type 1 diabetes, exogenous insulin must be administered for life.
- In type 2 diabetes, insulin may be necessary on a long term basis to control glucose level if diet and oral agents fail.
- In addition, some patients in whom type 2 diabetes is usually controlled by diet alone or by diet and an oral hypoglycemic agent
- May require insulin temporarily during illness, infection, pregnancy, surgery, or some other stressful event.

Cont---

- **Indications of insulin therapy includes**
  - Type I DM
  - DM with complication (DKA and HHNK)
  - During or after serious illness or infection
  - During surgery & pregnancy
  - NIDDM- resistant to diet & oral hypoglycemic agents
- N.B. Insulin injections are taken two times /day or
- Even more often to control post prandal & overnight increase in blood glucose.

Cont---

- ***Insulin preparation varies according to four main characteristics***
- Time course of action
- Concentration
- Source and manufacture
- ***Time course***
- Short - acting
- Intermediate acting
- Long acting insulin

Cont---

- **Short acting** e.g. regular crystalline and semilente
- Usually administered 20-30min before meal wither alone or in combination
- Route - Sc/IM/IV
- **Intermediate acting** e.g. lente insulin, isophane (NPH) and globin zinc insulin
- Usually taken after food
- Route - Sc only
- **long acting** eg. ultra lente, protamin zinc insulin (PZI)
- Route - SC only
- Some times referred to as " peak less " insulin because it tends to have long slow sustained action

Comparison of insulin preparations

Preparation	*Appearance*	*Action hrs*			*compatibly mixed with*
		onset	**peak**	**duration**	
short acing / semilente	clear cloudy	1/2 -1hr	2-4hr	6-8 hr	All insulin preparations
Intermediate acting	Cloudy	3-4hr	4-12hr	6-20hr	Regular
Long acting	Cloudy	6-8hr	12-16 hr	20-30 hr	Regular

Cont---

- ***concentration***
- Insulin dosage is always prescribed in units
- All type of insulin are prepared in 10 ml vials w/h contain either 40, 80 or 100U/ml
- ***species /sources***
- Insulin is obtained from beef/cow, pig/pork's pancreas & from human.
- Human insulin is now widely available
- Human insulin preparations have a shorter duration of action than insulin from animal sources

Cont---

- ***Insulin syringes***
- Insulin syringes must match with insulin concentration in the vial.
- Most insulin syringes have 27 to 29 gauge needle that is approximately 1/2 inch in the length.
- Currently, three size of insulin needle are available - 1 ml/cc syringe- hold 100U.
- 1/2 ml/cc syringe hold 50 U
- 3/10 ml/cc syringe hold 30 U

Fig. insulin syringes

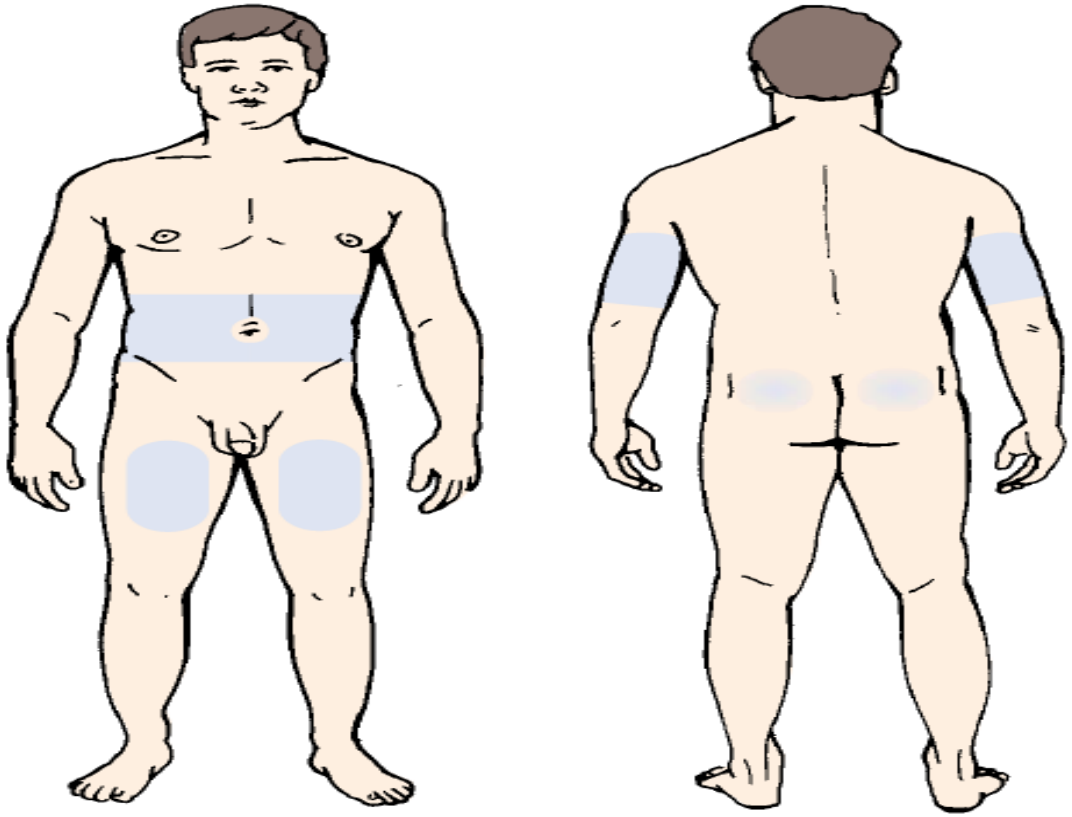
Cont---

- **Dosage**- varies with response to the patient and other factor like illness, stress , surgery, pregnancy etc.
- 0.5-1.0 U/Kg per day of Insulin.
- Adult - 15-20 u/d - initial therapy
- Obese - 25-30 u/day
- For BID Spilt insulin therapy 2/3 before break fast & 1/3 in the evening before dinner
- **Routes of Insulin Administration**
- Insulin can be given in Sc [the most common route], IM or IV.

Cont---

- **Insulin Administration Sites**
- The common insulin injection sites are the thighs, abdomen ,the upper arms & the buttock.
- Abdomen - is the best site
- Speed of absorption = Abdomen > arm > thigh > buttock
- Use available sites in one area and then rotate,
- Patient should not use the same site more than once with in 2-3 weeks.
- There should be ½ -1 inch gap b/n each injection site.

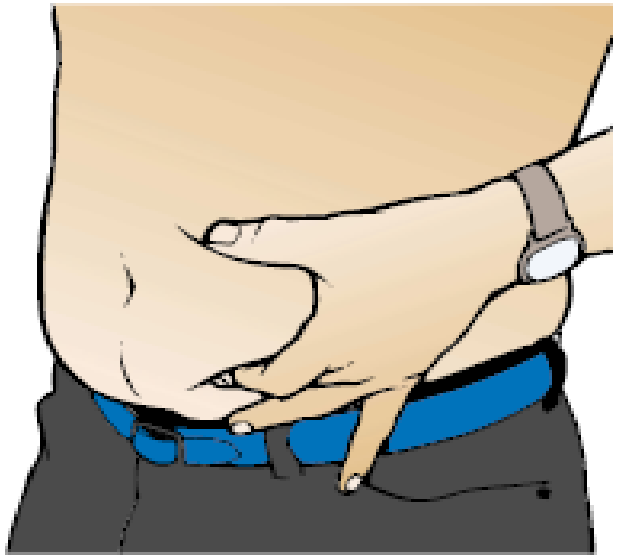
Fig. insulin administration sites



Cont---

- Systemic rotation of injection sites is important to:
- Prevent localized changes in fatty tissues / lipodystrophy.
- Promote consistency insulin absorption.
- **NB**: If the patient is planning to exercise, insulin should not be injected into the limb that will be involved in the exercise
- Because it will be absorbed faster & may result hypoglycemia.
- **Methods of needle insertion**:- bunching the tissue (pinching) - 45^0 or spreading - 90^0

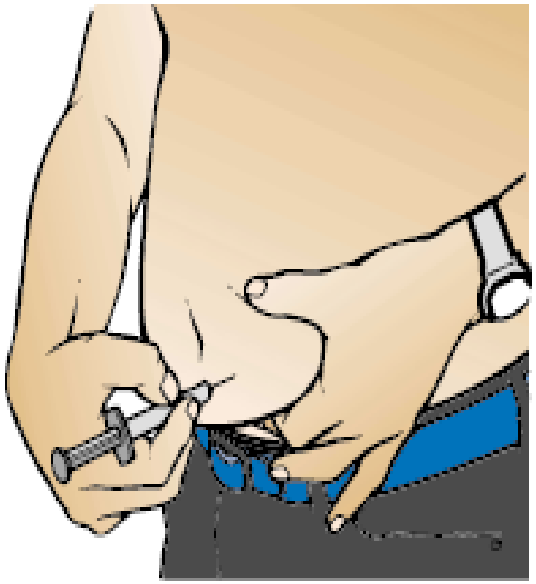
Methods of needle insertion



Pinching the skin

Inserting the needle into the skin

Cont---



Injecting the insulin

Removing the needle and holding cotton ball over site

Precautions

- **N.B:**
- Don't shake insulin but roll b/n hands.
- Don't administer cold (extremely freezed) insulin
- In mixing regular insulin with long acting insulin,
  - First draw the regular insulin in order not to contaminate the regular insulin
  - 1st from the cloudy vial & then from the clear vial
- Don't give insulin to NPO patient
- Always check the label on the insulin bottle the appearance of insulin (color)
- Prepare insulin at room temperature don't allow insulin to freeze extremeTemp.

Complications of Insulin Therapy

A) Insulin allergy – Local Vs Systemic

- **Local Allergic reaction.**
- Usually allergic to the protein component of the insulin.
- The patient may have redness, swelling, tenderness & indurations of the site 1 or 2 hrs after injection.
- Usually occur during the beginning stage of therapy & disappear with continued use of insulin
- ***Rx-*** antihistamine may be prescribed 1 hr before injection.
- **Systemic allergic reaction-** rare
- **Rx-** desensitization with small dose of insulin & gradually increase the dose.

Cont---

B) Insulin Lipodystrophy

- Lipodystrophy refers to a localized disturbances of fat metabolism.
- It may be lipoatrophy or lipohypertrophy.
- **Lipo atrophy -** is loss of subcutaneous fact or depression at the site of injection.
- Lipo hypertraphy (some times called ***insulin tumor***) is a thickening of the subcutaneous tissue at injection site.

Cont---

- Lipodystrophy may be associated with:
- The use of cold insulin
- Failure to rotate the sites & injection of insulin directly in to fat

Rx-

- Avoid the affected areas with good rotation plan
- Use warm insulin to room temperature.
- Rotate the injection site systematically
- Injection insulin in to the pocket b/n the fat & muscle

Cont---

C) Insulin Resistance

- ~ is need of more insulin for the control of diabetes (a daily requirement of 100 units or more).

Cause –

- The exact cause is unknown but may be caused by;
  - Specific insulin antagonists with in blood
  - Circulating antibodies which are destructive of insulin
  - Obesity

Cont---

- It can be classified as:-
- Mild resistance 80-125U required /day
- Moderate resistance 126-200 U /day
- Sever resistance more than 200U /day
- ***Mgt***-
  - Exercise
  - Prednisone - to block the production of antibodies
  - Use pure insulin preparation

Cont---

D) Hypoglycemia (insulin shock)- occurs when the blood glucose level drops to 60 mg/dl or less.

- **Cause** - usually, insulin over does -

  - over exercise

E) Hyperglycemia - occurs when the blood glucose concentration is too high (> 180 mg/dl).

Oral anti diabetic Agents

- Oral anti diabetic agents may be effective for type II diabetic patient who cannot be treated by diet & exercise alone,
- However they cannot be used during pregnancy.

➢ It includes

  - sulfonylureas
  - Biguanides

Cont---

A) Sulfonylureas

- Stimulate the release of insulin from the β- cells of the pancreas,
- Also reduce the glucose output from the liver & improve insulin sensitivity.

➢ **Examples**

- Tolbutamide (Restinon) 0.5 - 3.0 gm BID /TID
- Chlorpromide (Diabinase)- for IDDM only - 100-500 mg/d
- Glipizide - 5-40 ml/d
- Glibenclamide (Donil) 25 -20 mg/d (1-2X/d)- maximum dose 20 mg/day -most commonly used

Cont---

B) Biguanides

- Inhibit gluconeogenesis there by leading to lowered blood glucose level.
- Facilitate insulin's action on peripheral receptor sites
- It is used only in the presence of insulin because they don't have any effect on pancreatic β-cells.

➢ E.g.

- Phenformin - not commonly used, safer but unavailable
- Metiformin 500 mg/day

Cont---

- Approximately half of all patients who initially use oral anti diabetic agent eventually require insulin.
- This is referred to as a ***secondary failure***.
- ***Primary failure*** occurs when the blood glucose level remains high amount after the initial medication use

Education

- The overall overview of education in DM patient's has a broad ,generally it includes
- Teaching patients to self-administer insulin
- Routes of insulin administration
- Systematic rotation of injection sites
- Avoid use of alcohol to cleanse the skin
- How to keep the foot clean, wear shoe
- To have diabetic ID card or bracelet
- Signs of hypoglycemia
- About diet , medication and exercises
- The natures of the diseases etc

Complications of Diabetes

A) Acute complication

- There are three major acute complication of diabetes related to short-term imbalance in blood glucose levels.

➢ **Includes**

- Hypoglycemia [insulin reaction/ insulin shock]
- Diabetic ketoacidosis [DKA]
- Hyperglycemia hyperosmolar non ketotic coma [HHNK]

Cont----

1) Hypoglycemia

- When blood glucose level falls below 50-60 mg/dl

❖ **Cause**

- To much insulin or oral hypoglycemic agents
- Too little food or late lack of meal after insulin
- Excessive physical activity

N.B. It may occur at any time of the day or night.

Cont---

- **Management**
- For conscious patient : oral glucose 20-30gm/2-3 TSP/ in water or tea and regular meal
- For unconscious patient /severe hypoglycemia: 25-50 ml of 50 % dextrose in water IV
- If available, glycogen 1 mg Sc or IM/stimulates the liver to release glucose through the break down of glycogen

Cont---

2) Diabetic ketoacidosis /DKA

- When glucose level is > 300 mg/dl
- DKA result from relative or absolute insulin deficiency combined with counter regulatory hormone excess (glycogen catecholamine's, cortisol & growth hormone)
- Both insulin deficiency & glycogen excess are necessary for DKA to develop.
- This results in disorder of CHO , fat & protein metabolism.

Cont---

- **Cause**
- Three main causes of DKA are
- A decrease or missed dose of insulin /insulin withdrawal
- An illness or infection such as skin , UTI, lung etc
- The initial manifestation of undiagnosed & untreated diabetes

C/M

- **C/M**
- The three main problems /clinical features of DKA are
- Dehydration
- Electrolyte loss
- Acidosis

Cont---

- ***LAB-VALUES***
- Blood glucose level from 300mg -800 mg/dl (may be lower or higher)
- Low serum bicarbonate 0-15 meg/L
- Low p^H (6.8-7.3) low Pco2 (10-30 mm Hg)
- Na & K levels may be low, normal or high depending on the amount of water loss (dehydration).
- Elevated creatinine.

Cont---

- ***MANAGEMENT OF DHN***
- A patient may need up to 6-10 liters of IV fluid to replace the fluid loss.
- Initially 0.9% Ns is administered at a high rate of 0.5 -1 lit/hr for 2-3hrs (0.45% ns may be used for HTN, CH for hypernatremia)
- 0.45 % Ns is fluid of choice after the 1st few hours provided that BP is stable & sodium level is not low
- Monitor fluid volume status intake & out put .
- Initial urine out put will lag behind IV fluid intake due to DHN.

Cont---

- ***MANAGEMENT OF ELECTROLYTE LOSS***

- Potassium the main electrolyte of concern in the Rx of DKA
- Cautious replacement of potassium is vital for avoidance of serve cardiac dysarrhythmias that occur with hypokalemia.
- Observe for signs of hyperkalemia.

Cont---

- ***MANAGEMENT OF ACIDOSIS***
- Infuse insulin at slow continuous rate e.g. 5u/hr.
- Monitor blood glucose values hourly
- Add dextrose to IV when blood glucose reaches 250-300 mg/dl to avoid too rapid drop in blood glucose
- Insulin must be infused continuously until SC administration of insulin is resumed.
- Iv insulin must be continued until the serum bicarbonate improves & patient can eat.

Cont---

- **Prevention & Education**
- Teach patient not to eliminate insulin doses when sick & when nausea & vomiting occur
- Teach patients to take their usual insulin doses
- Check blood glucose Q 3-5 hrs
- Teach insulin self injection, blood glucose testing & assess skills.

Cont---

3) Hyperglycemic Hyperosmolar non ketotic coma/syndrome [HHNS]

- Is a situation in which hyperglycemia & hyperosmolarity predominate with alterations of senserium (sense of awareness).

➢ **Cause**

- Relative insulin deficiency and/or
- Lack of effective insulin
- ketosis is minimal or absent

Cont---

- Insulin deficiency increases hepatic glucose production(through glucogenolysis & gluconeogenesis) and impairs glucose utilization in skeletal muscle⇨ hyperglycemia ⇨osmotic diuresis ⇨ intravascular volume depletion which is exacerbated by inadequate fluid replacement.
- Even through is no enough insulin to prevent hyperglycemia it is enough to prevent fat breakdown.

Cont---

- Occurs most frequently in older people (50-70yrs)
- Who have had no previous history of diabetes or only mild type II diabetes .
- Precipitated by acute illness;
- MI, stroke, pneumonia
- Ingestion of medications known to provoke insulin insufficiency (thiazide diuretics, propronol)
- Therapeutic procedures like peritoneal/hemodialysis.

Cont---

- ***Clinical Manifestation***
- Polyuria & polydypsia for days to weeks
- Weight loss
- Hypotension, tachycardia
- Profound DHN (dry mucus membranes, poor skin turgor)
- Altered mental status (confusion lethargy or coma)

Cont---

- **Management**
- Similar to DKA
- Fluid replacement
- Correction of electrolyte imbalances
- Insulin administration to prevent hyperglycemia

Comparison of DKA & HHNK

	DKA	HHNK S
Age	All ages	Usually over 50 years
Duration of DM	Variable	Recent onset
Precipitating factors	Infection. Stress	Infection, steroids. Diuretics
Mortality	5%	50%
Blood sugar	300 -800mg/dl [usually >250mg/dl]	>900mg/dl [usually >600mg/dl]
Dehydration	Variable [total body weight loss 5 -15%	Sever [total body weight loss 5-25%]
PH	Low	Normal
Breathing	Kussmaul	Normal
Serum acetone	Present	Absent

Long term complications of Diabetes

- The long term complication of diabetes can affect almost every organ system of the body.
- The general categories of chronic diabetic complications are :-
  - MACROVASCULAR DISEASE
  - MICOVASCULAR DISEASE and
  - NEUROPATHY

Macrovascular Disease

- Diabetic macrovascular complications result from changes in the medium to large blood vessels.
- Blood vessels walls thicken, scleroses, and become occluded by plaque that adheres to the vessel walls.
- Eventually, blood flow is blocked.

Cont---

- The three main types of macro vascular complications that occur more frequently in the diabetic includes
- Coronary artery disease (CAD),
- Cerebro -vascular disease (CVD), and
- Peripheral vascular disease (PVD).

Microvascular Complications

- Diabetic microvascular disease is characterized by capillary basement membrane thickening.
- Increased blood glucose levels react through a series of biochemical responses to thicken the basement membrane to several times its normal thickness.

Cont---

- The two areas affected by these changes are the **retinal** [retinopathy] and the **kidneys** [nephropathy]
- **Diabetic retinopathy** is the leading cause of blindness in people with diabetes.
- Similarly, about one in every four individuals starting dialysis has **diabetes nephropathy** (it is the leading cause for ESRF)

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---End---