

Diabetes Mellitus and Surgery

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Diabetes Mellitus – In surgeon's view point

Diabetes Mellitus is an endocrine disorder affecting body metabolism, which changes the response of tissue to external or internal injury

- A Diabetic patient should not be denied surgery because he is diabetic
- Every patient is surgical diabetic at least once in his lifetime

Classification & Diagnosis

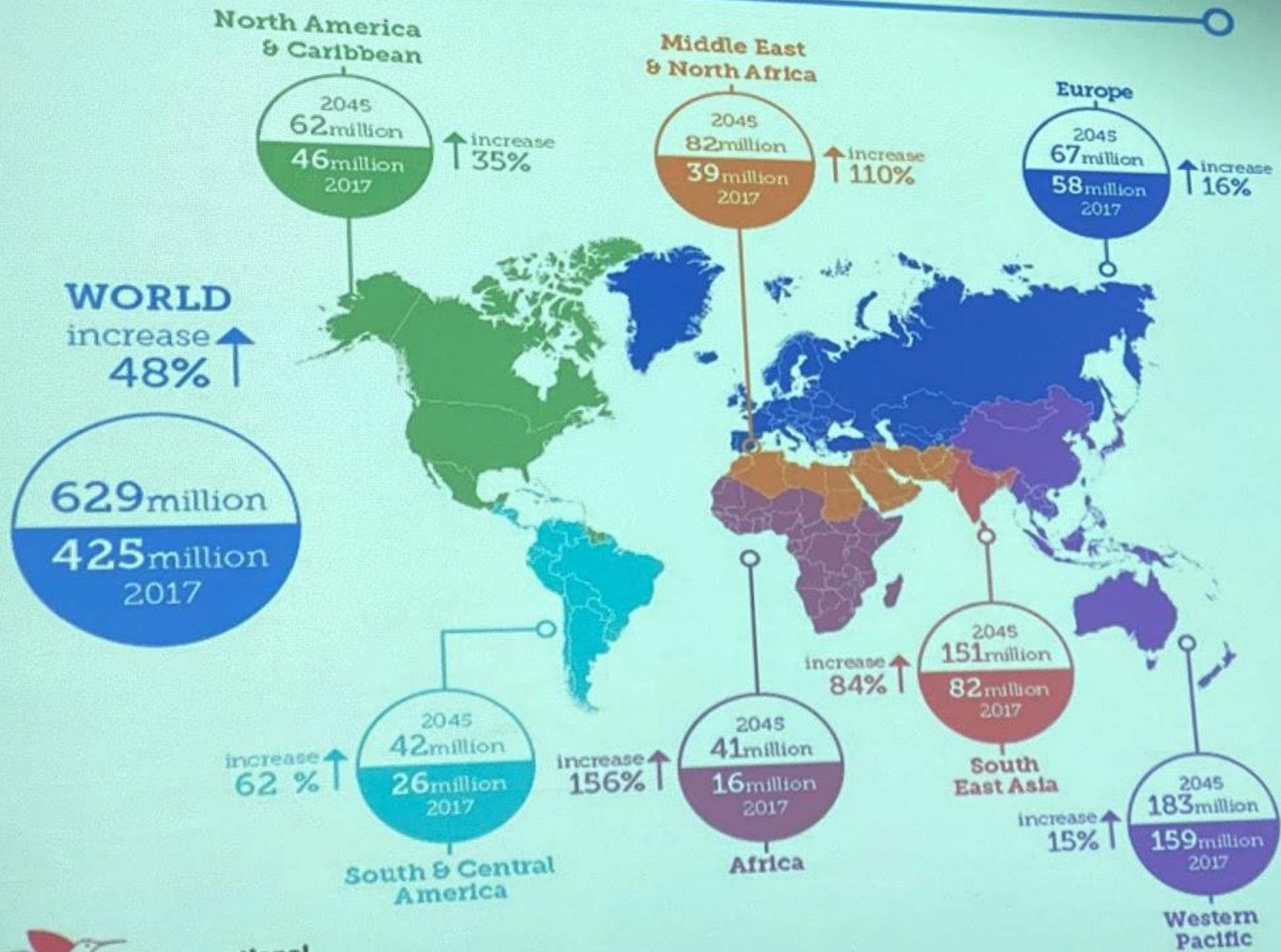
- ◉ Classification
- ◉ Diagnostic Tests for Diabetes
- ◉ Prediabetes
- ◉ Type 1 Diabetes
- ◉ Type 2 Diabetes
- ◉ Gestational Diabetes

American Diabetes Association Standards of Medical Care in Diabetes.
Classification and diagnosis of diabetes. Diabetes Care 2017; 40 (Suppl. 1): S11-S24

Classification of Diabetes

1. **Type 1 diabetes**
 - β -cell destruction
2. **Type 2 diabetes**
 - Progressive insulin secretory defect
3. **Gestational Diabetes Mellitus (GDM)**
4. **Other specific types of diabetes**
 - Monogenic diabetes syndromes
 - Diseases of the exocrine pancreas, e.g., cystic fibrosis
 - Drug- or chemical-induced diabetes

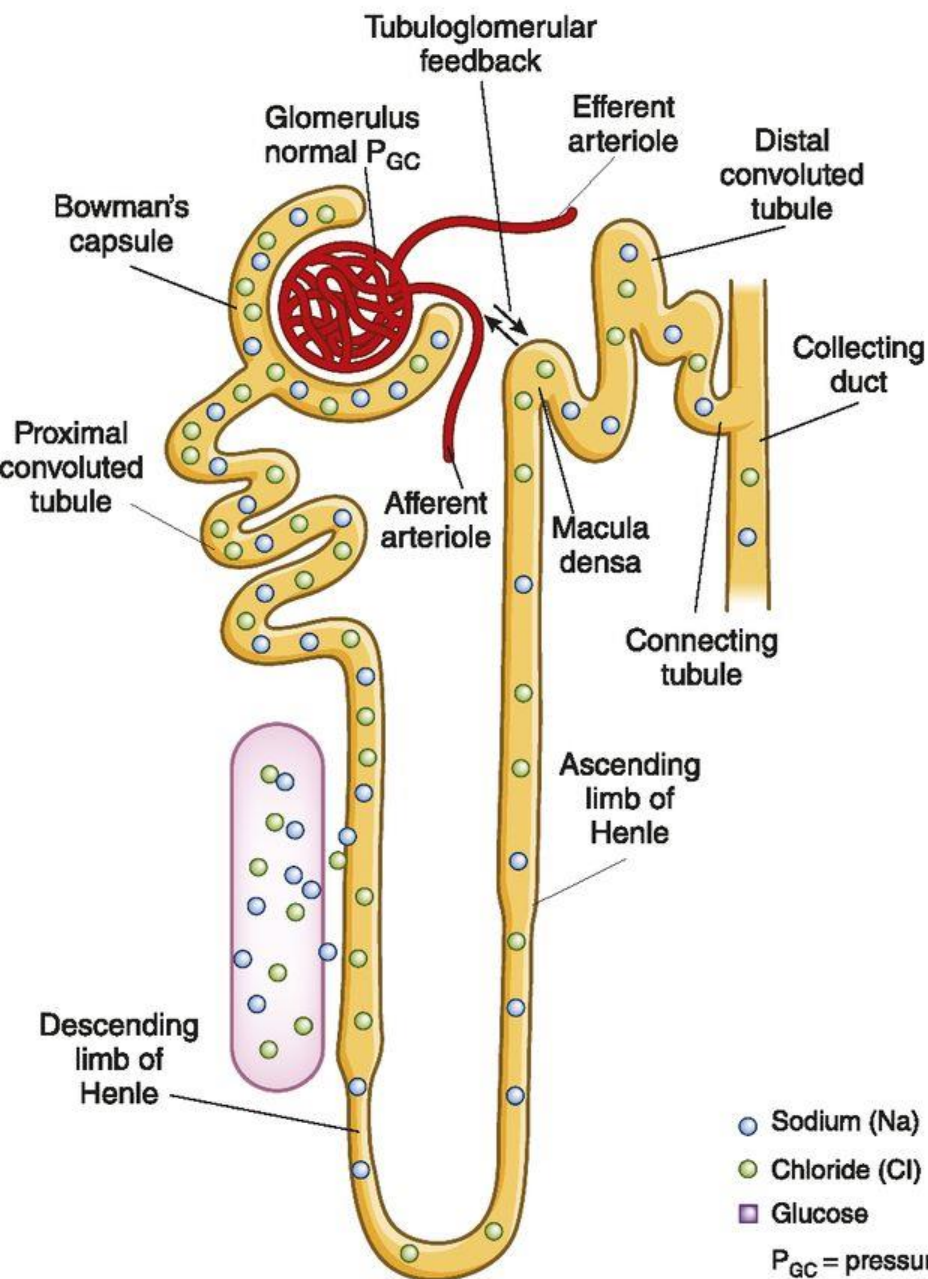
Number of people with diabetes worldwide in 2017 and 2045 (20-79 years)



Pathology

- Protean manifestation
- Basic pathology-microangiopathy
- Vessels:
 - Vascular insufficiency, C.V.A.,
 - Predisposes atherosclerosis
- Kidney:
 - KW Syndrome : Interstitial Glomerulonephritis
- Retina:
 - Diabetic Retinopathy, Cotton Wool,
 - Flame shaped H'ages
 - Predisposes retinal detachment
- Pregnancy: Big baby syndrome,
● Obstructed labour.

A Normal



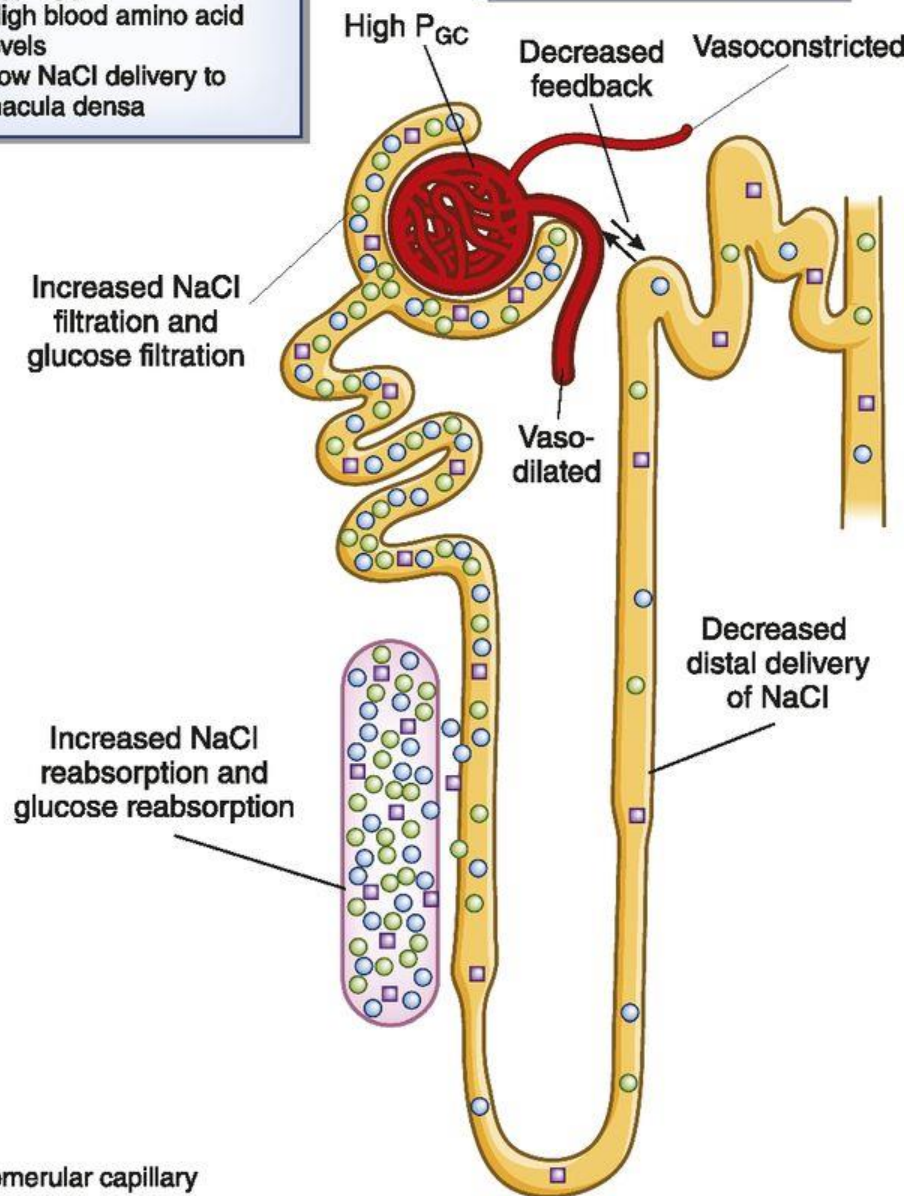
B Diabetes

Afferent vasodilation:

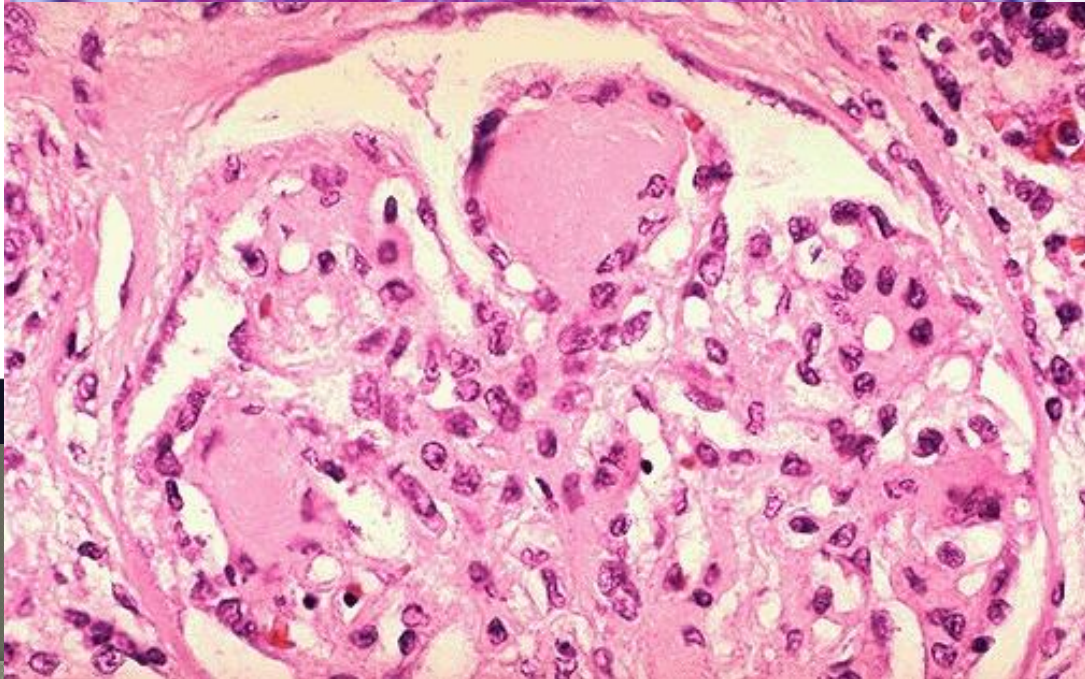
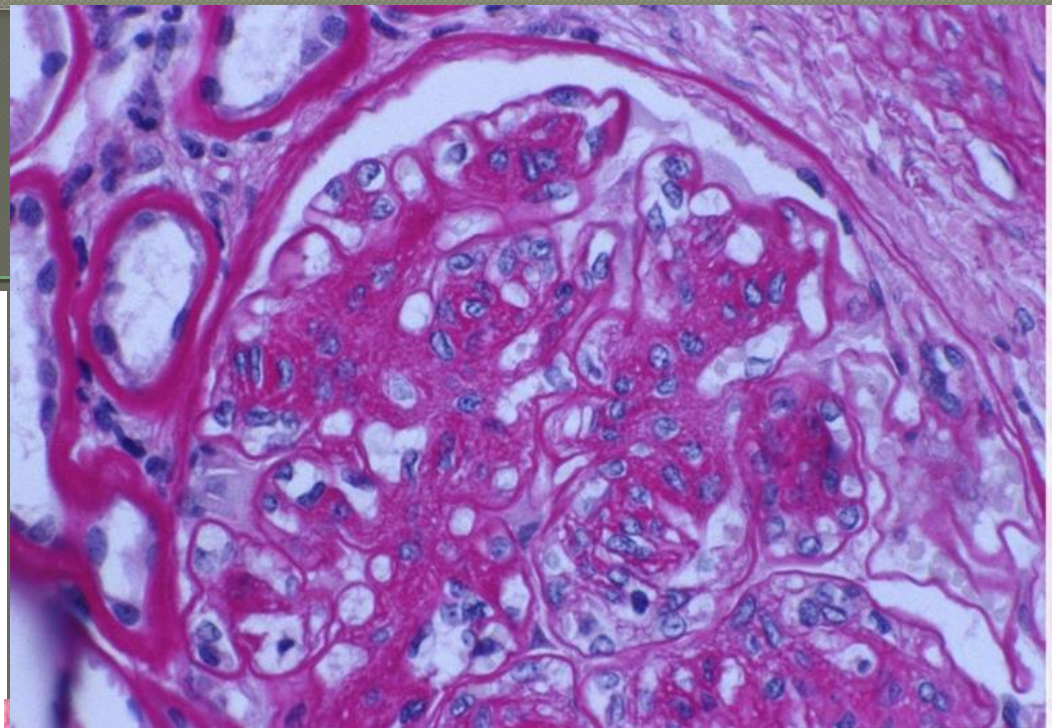
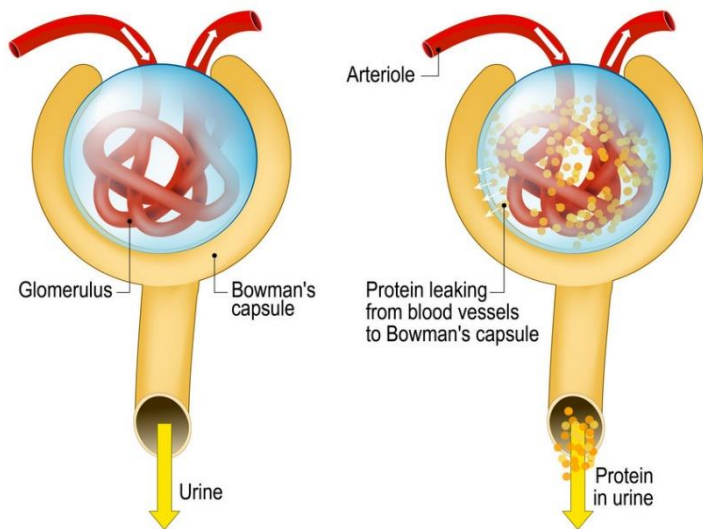
- Hyperglycemia
- High blood amino acid levels
- Low NaCl delivery to macula densa

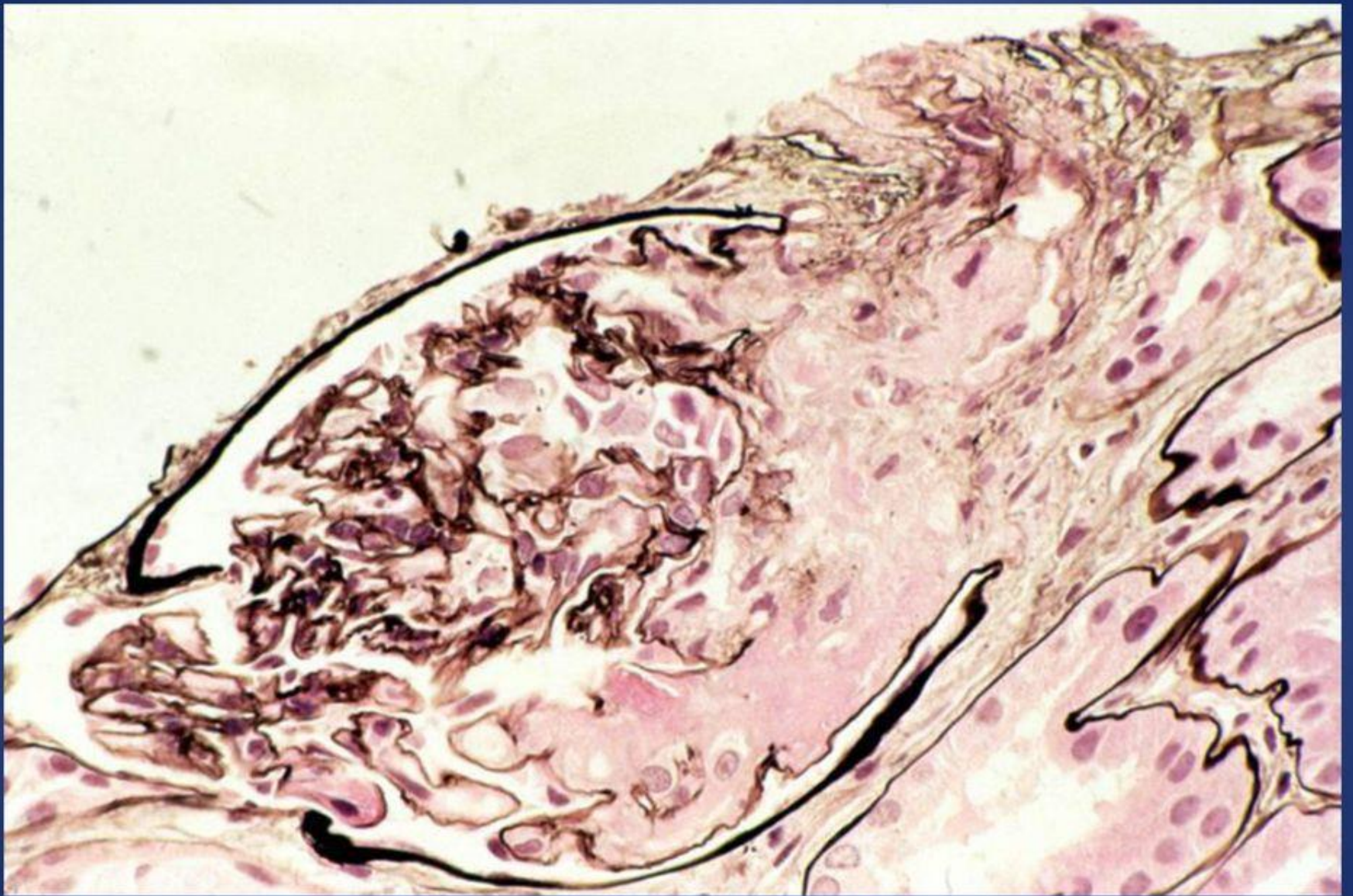
Efferent vasoconstriction:

- High local angiotensin II level



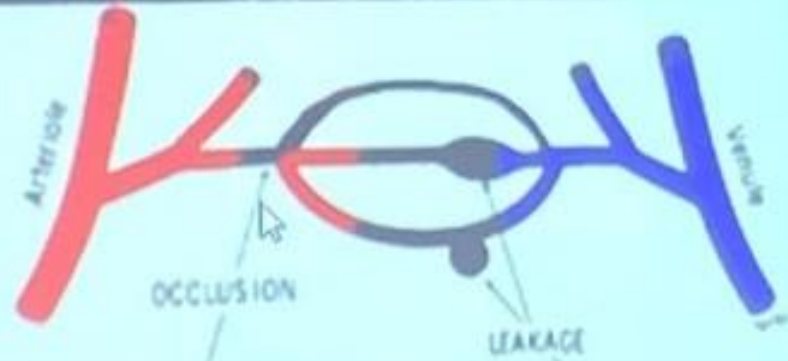
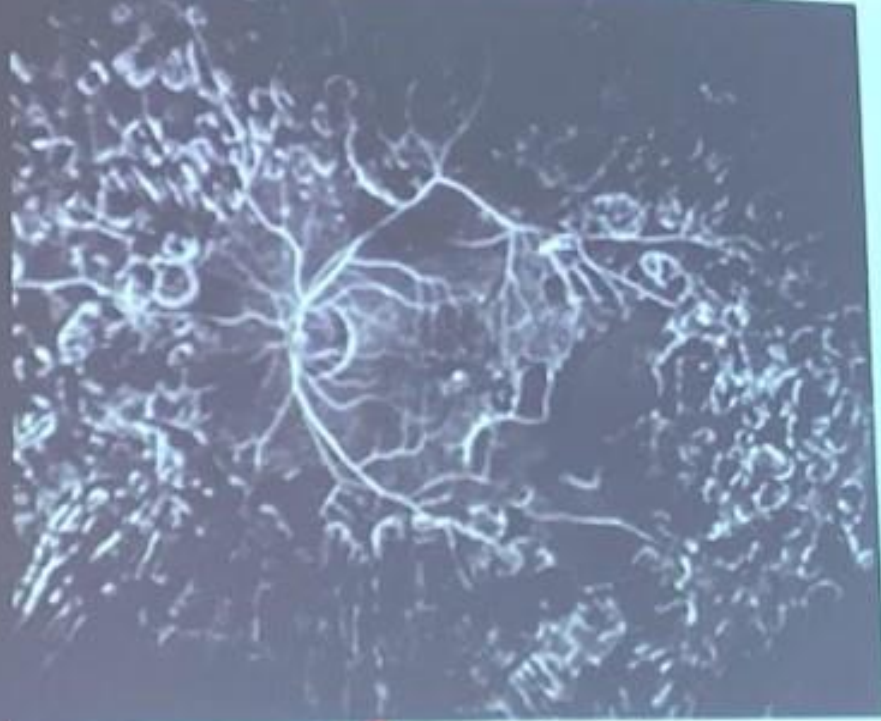
DIABETIC NEPHROPATHY



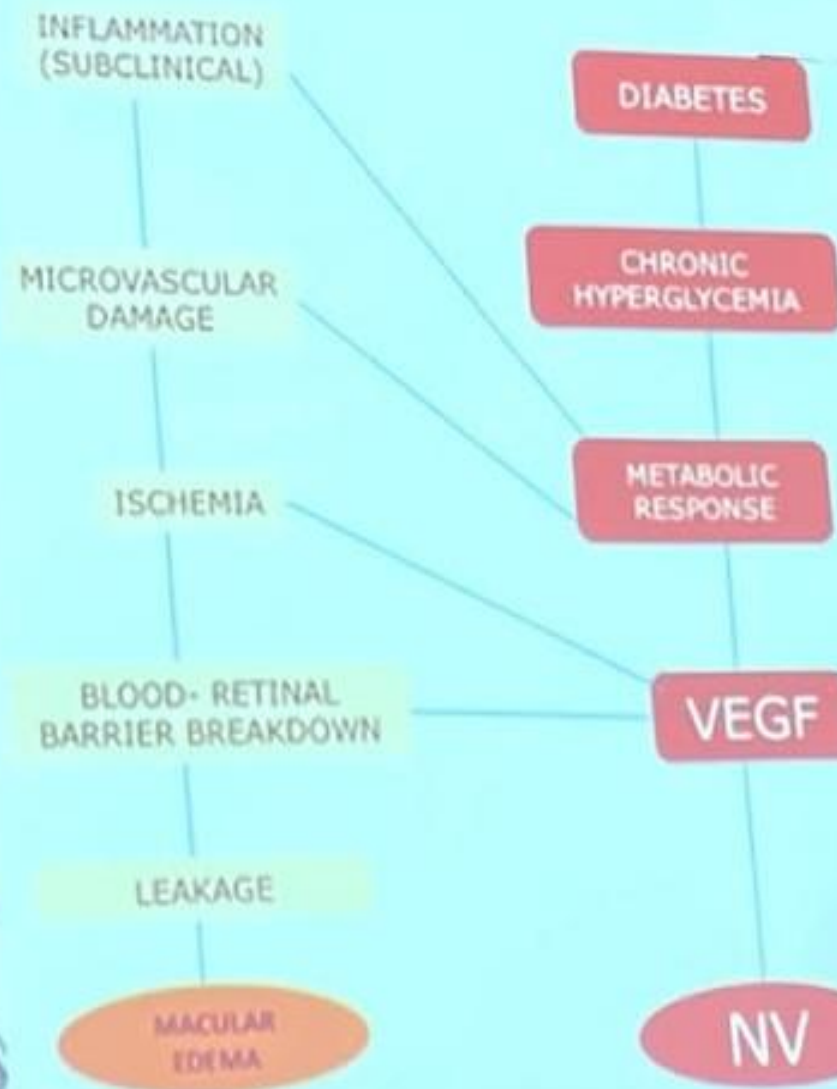


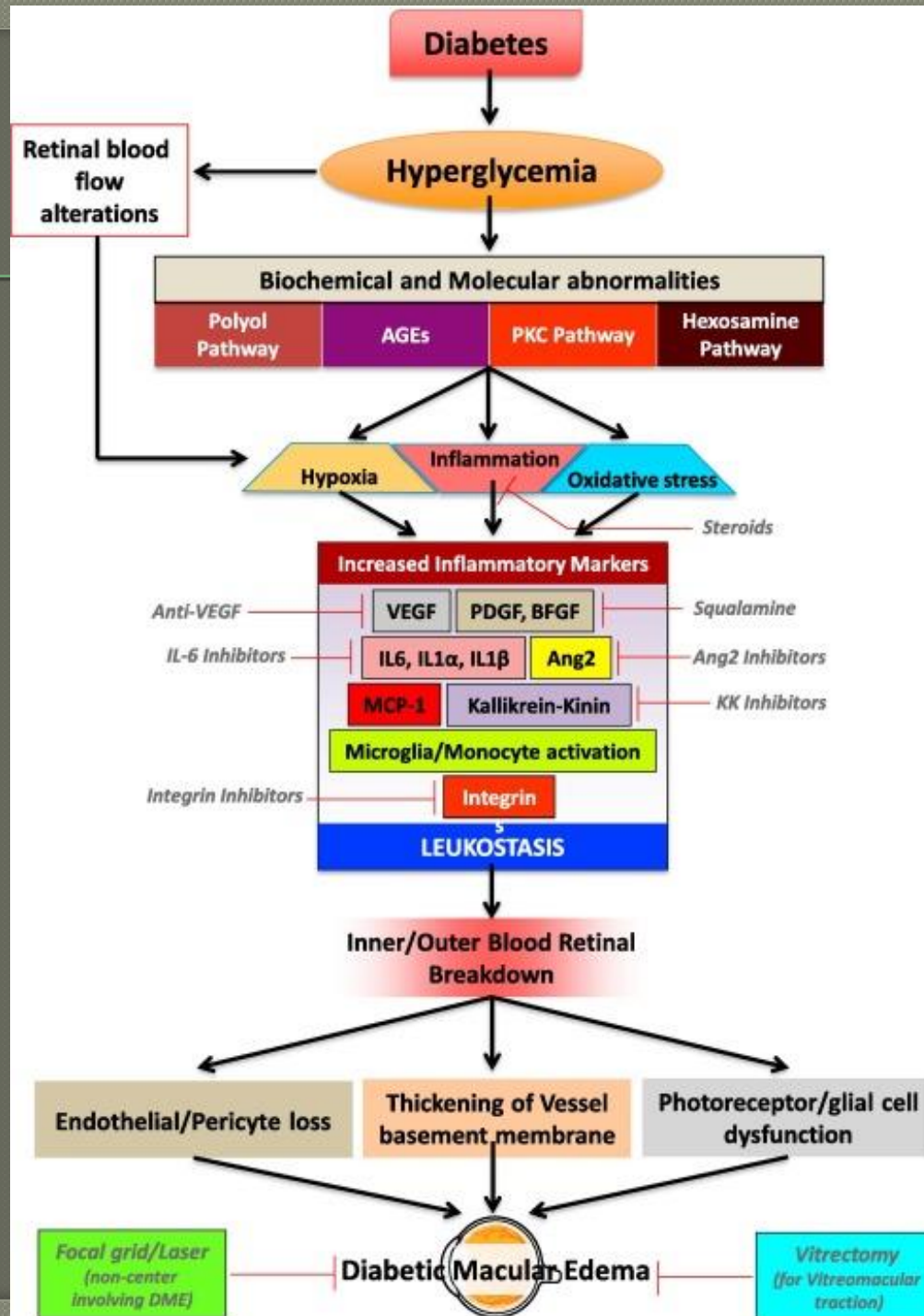
Fibrin thrombi extending from glomerulus into arteriole in thrombotic microangiopathy (Jones' silver stain) –Agnes Fogo

Pathophysiology



1. Basement membrane thickening
2. Endothelial cell damage





Novel Pharmacotherapies for DME based on mechanism of action

Anti-VEGF

- Pegaptanib
- Bevacizumab
- Ranibizumab
- Aflibercept
- VEGF DARPIn

Inhibitors of Multiple Growth Factors

- Sirolimus (mTOR)
- PF-655 (RTP 801 gene)
- iCo-007 (cRaf kinase)
- Squalamine
- (VEGF, bFGF, PDGF)

NSAIDs

- Aspirin
- Nepafenac
- Bromfenac

Integrin Inhibitors

- VAP-1 inhibitor
- α -b Integrin inhibitor (ALG-1001)

Anti-inflammatory

- Steroids (Triamcinolone, Dexamethasone, Flucinolone acetate)
- Betamethasone microspheres
- Loteprednol
- Danazol

Cytokine/ Chemokine Inhibitors

- Infliximab (TNF α)
- Ang-2 inhibitor
- CCR2/CCR5 Inhibitor
- Minocycline
- KK- inhibitor

Others

- Exenatide
- Lanreotide
- IGF- 1R Blocker
- EPO
- Mecamyl-amine

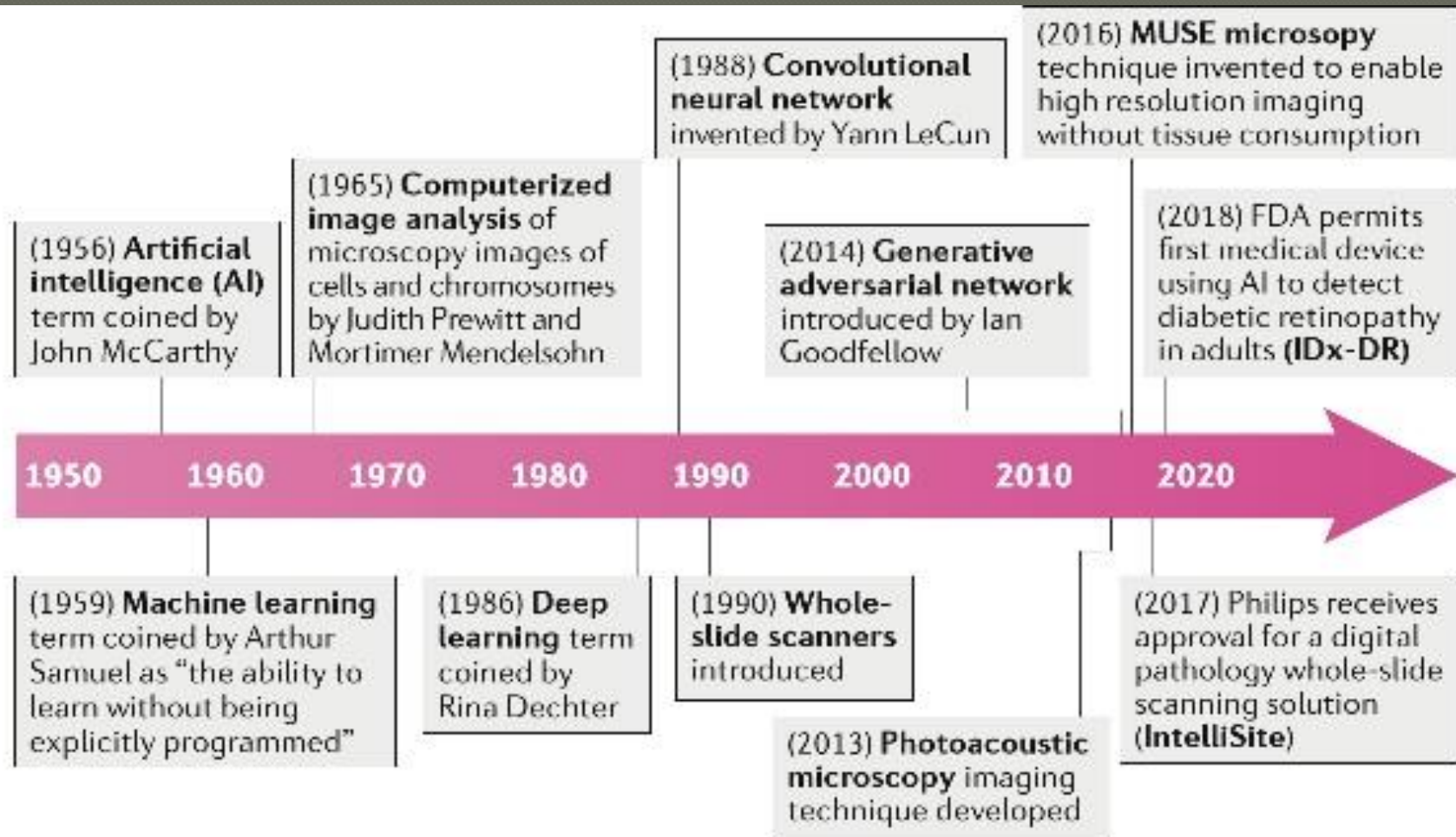


Fig. 1 | Milestones in computational pathology. Over the past two decades, technological advances have enabled efficient digitization of whole-slide images, subsequently helping to streamline pathology workflows across pathology labs worldwide. Slide digitization has enabled the creation of large-scale digital-slide libraries, the most popular of which is probably The Cancer Genome Atlas¹⁸⁸, which has enabled researchers around the world to freely access a richly curated and annotated dataset of pathology images linked with clinical, outcome and genomic information, in turn spurring substantial research activity into artificial intelligence for digital pathology and oncology¹⁸⁹.



by Nick Paul Taylor | Apr 13, 2018 7:55am



Eyenuk Inc.'s AI-based diabetic retinopathy screening software EyeArt™
tested with portable smartphone-based imaging device in new study
indicating potential for highly sensitive yet cost-effective mass retinal
screening

Automated Lesion
Detection and Localization



D.M AND SURGERY

Surgical conditions produced or aggravated in Diabetes mellitus

Surgical conditions modified in DM

Diabetes mellitus producing diagnostic problems

Surgery in Diabetics

Surgery for relief of Diabetes Mellitus

Surgical conditions either produced or aggravated by D M

- Septic lesions
- Neuropathic lesions
- Ischemic lesions
- Mixed

Surgical conditions produced or aggravated

● a) Septic lesions

- Presenting feature of uncontrolled D M rapid course
- Aggravates diabetic pathology
- Converts a potential D M / Manifest D M
- Fulminating infection
- Diminished cellular resistance.

Septic conditions

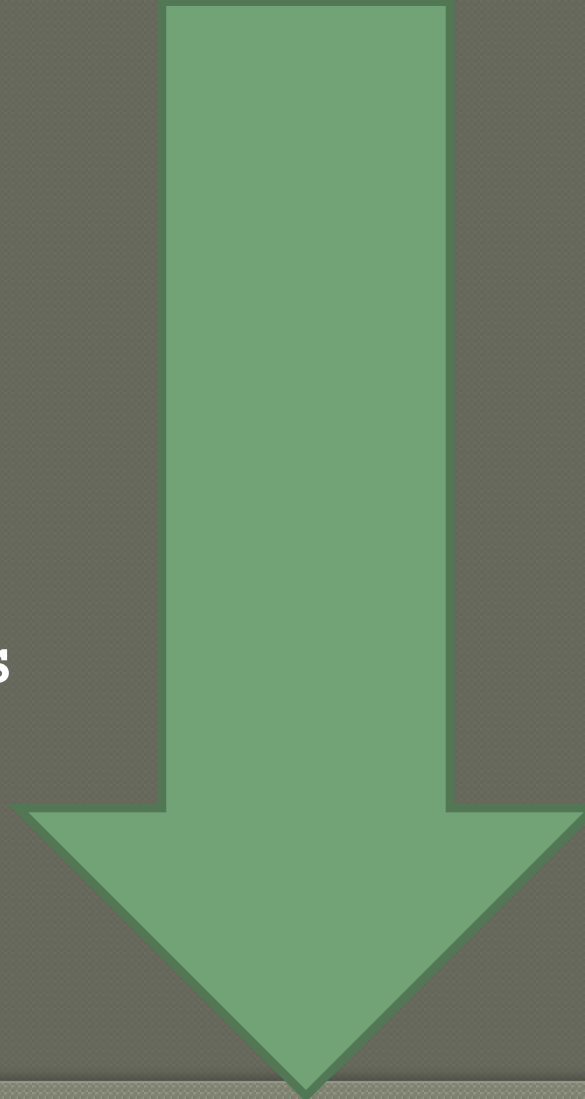
- ◉ Cellulitis, carbuncle, Abscess,
- ◉ Furunculosis , Infective gangrene ,
Osteomyelitis, Urinary tract infections,
- ◉ Respiratory tract infection



Sequel Fast action

- Blister
- Cellulitis –
- Tenosynovitis

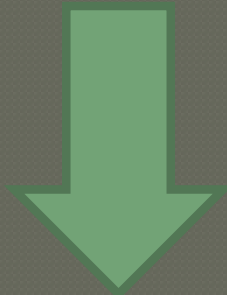
- Osteomyelitis
- Infective thrombosis
- Wet gangrene
-



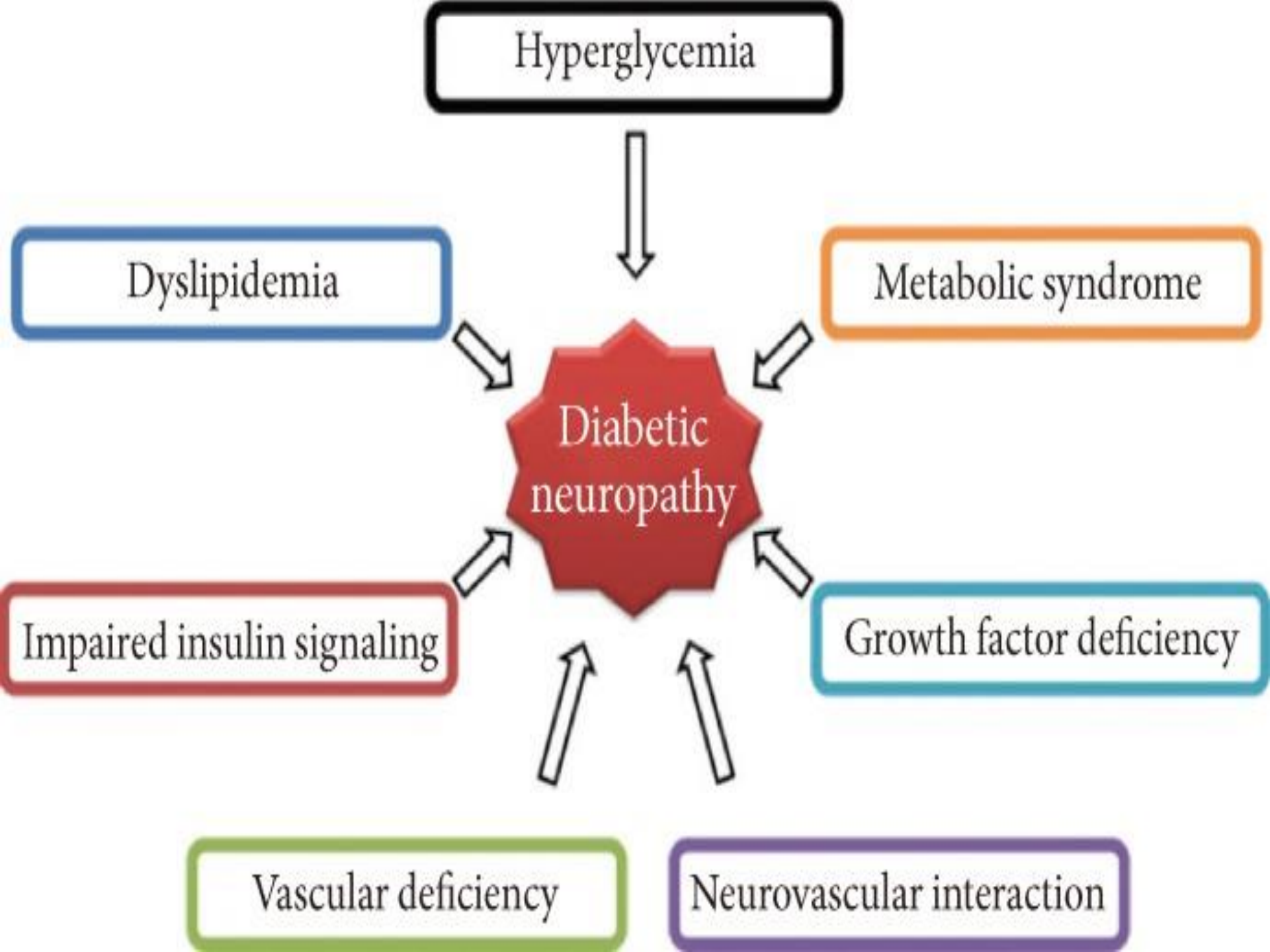
Neuropathic lesions

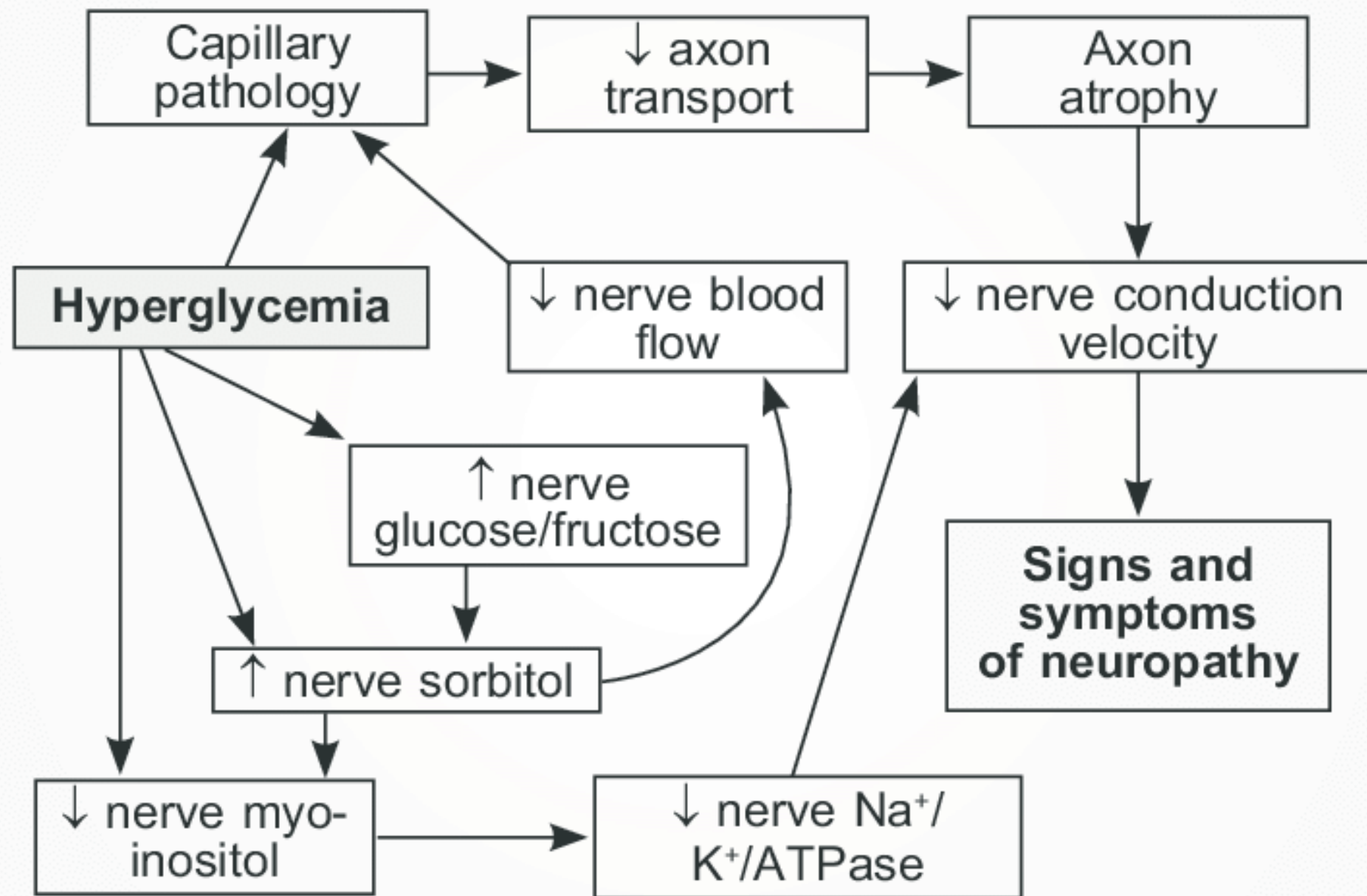
Nervous system (CNS) cannot metabolize anything except carbohydrates

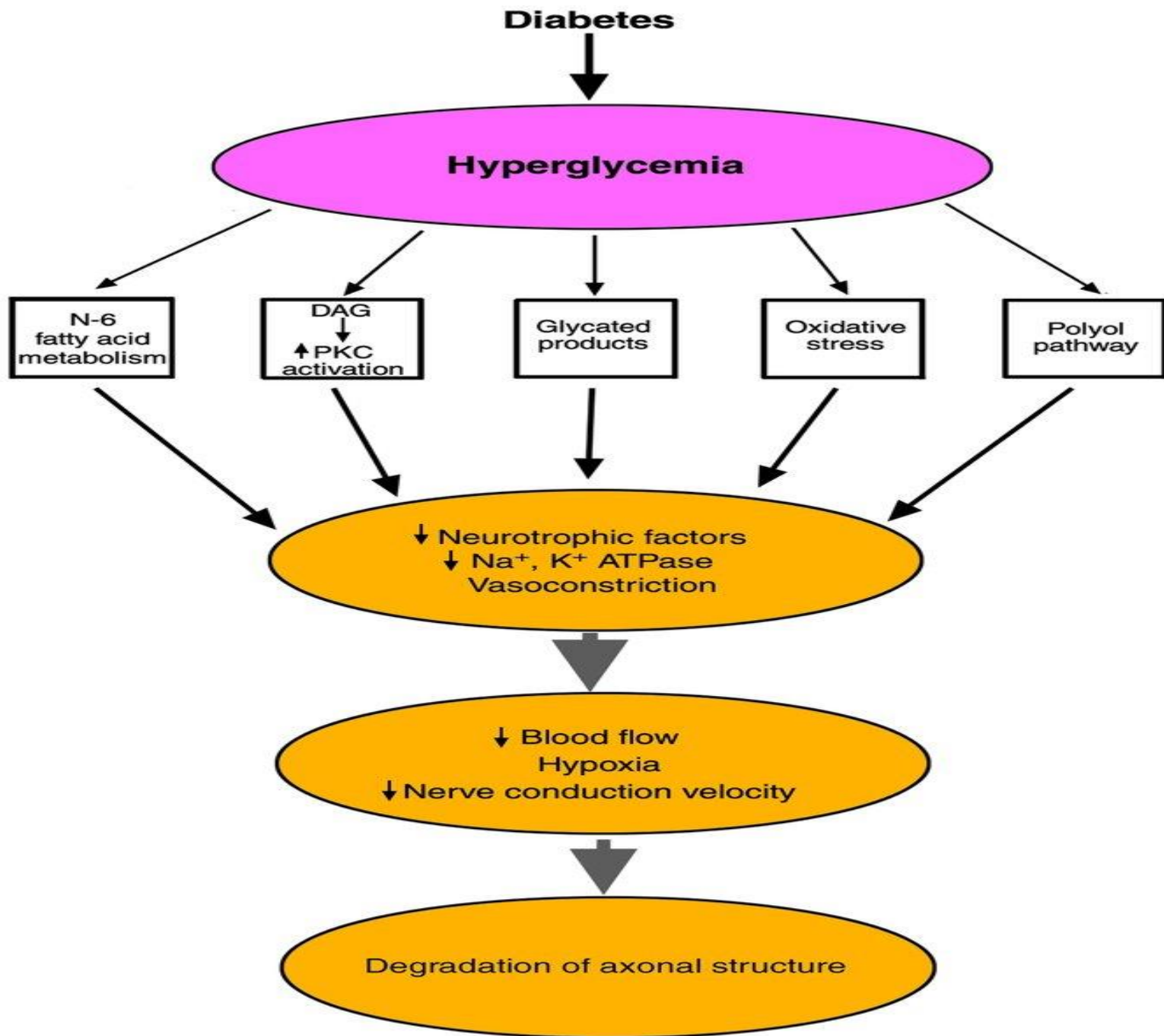
- Sugar utilization at tissue
- Defects in nerve conduction



Peripheral neuritis







Neuropathic lesions

Presentation depends upon type of nerve involved:

- Sympathetic: Flushing of face
Abnormal vasomotor response
- Superficial : Painless perforating ulcers
Sensory Trophic ulcer over pressure point
- Deep Sensory: Diabetic form of Charcot's joint
- Motor : Unbalanced paralysis
Clawing of hand
Usually combined features

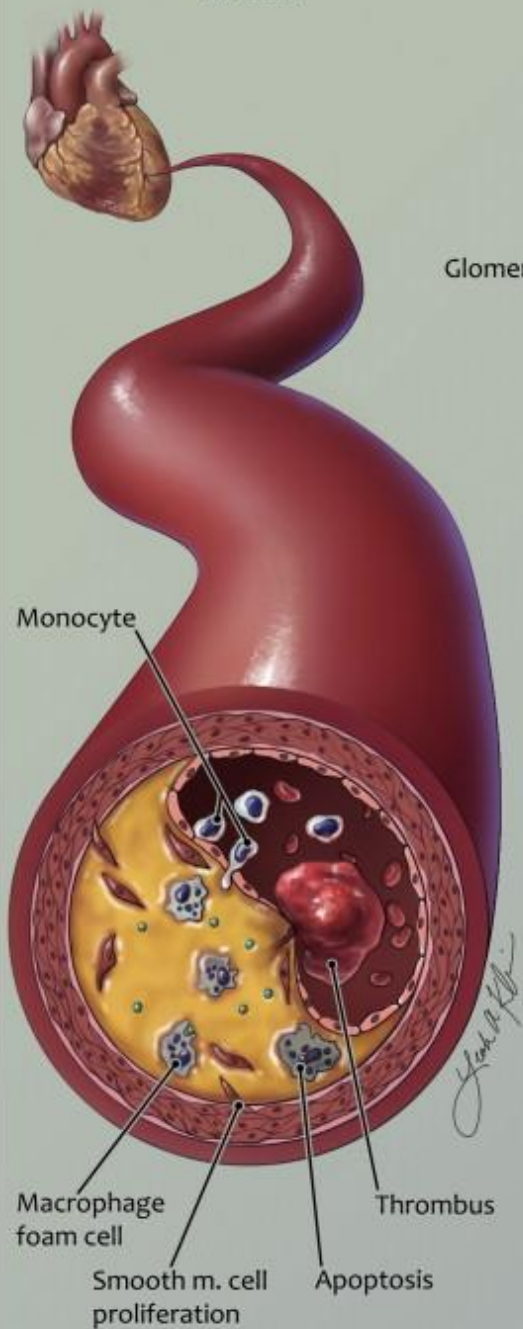
Ischemic lesions

Basic lesion of microangiopathy-
Combined with Atherosclerosis
Two types:

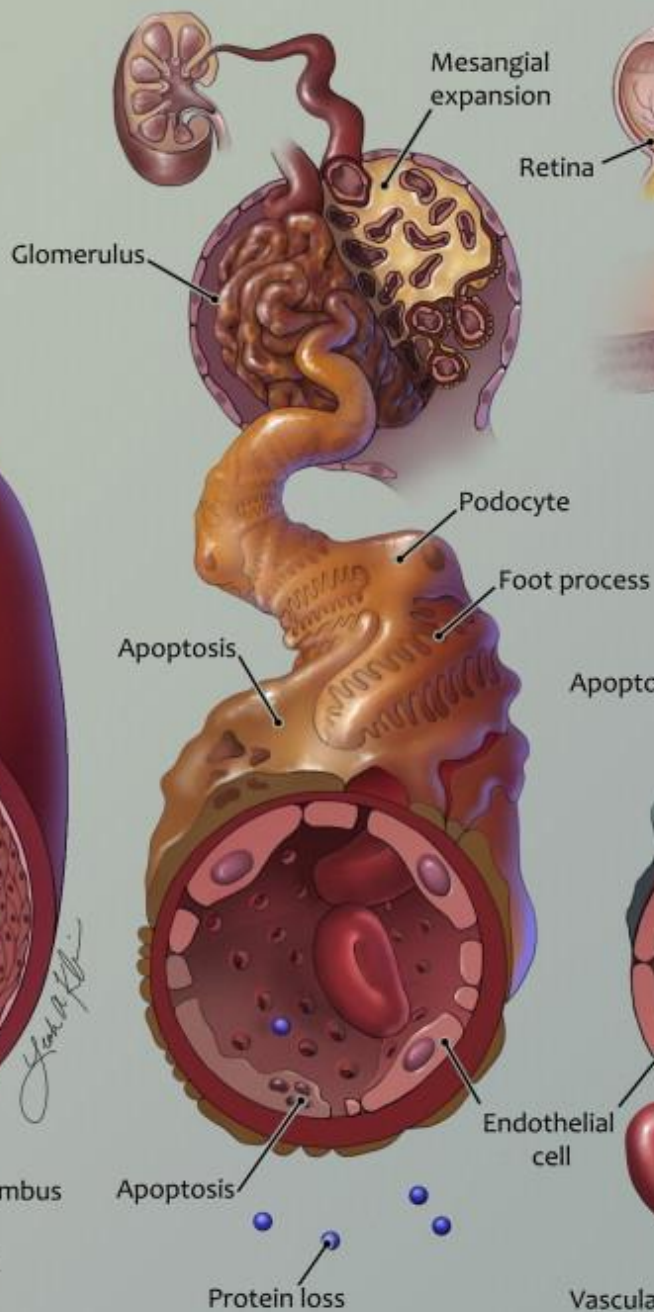
- **Progressive vascular occlusion**
Intermittent claudication
Dry gangrene
- **Sudden Vascular occlusion**
Ischemic thrombosis in
Septic lesions
Embolism.



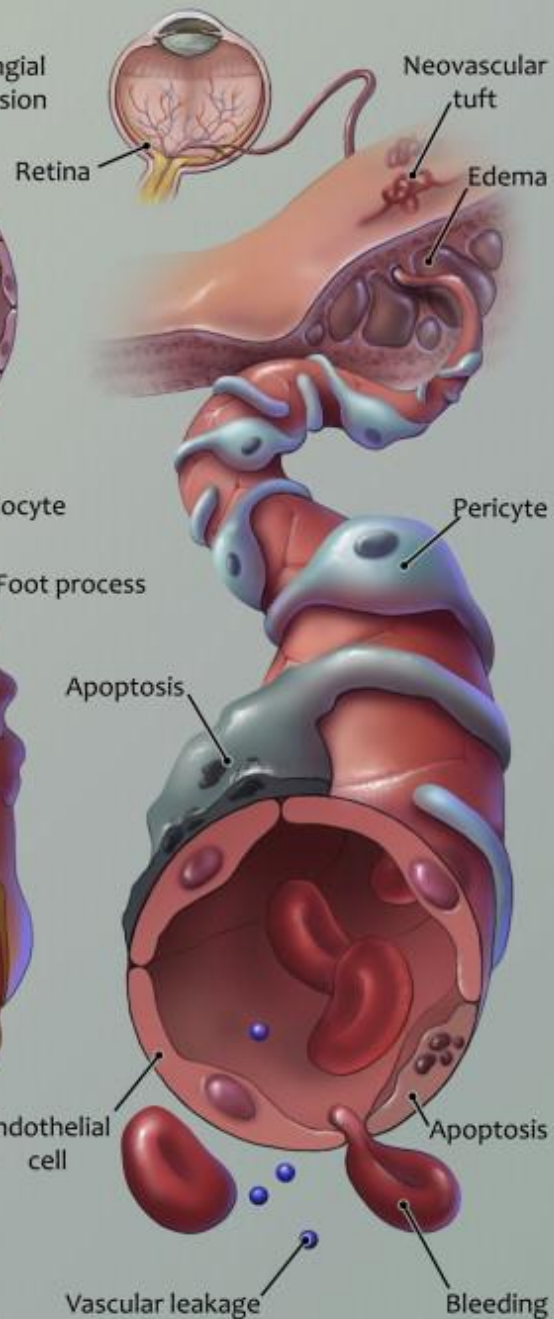
ARTERY



GLOMERULAR CAPILLARY



RETINAL CAPILLARY



Major Complications of Diabetes

Microvascular

Eye

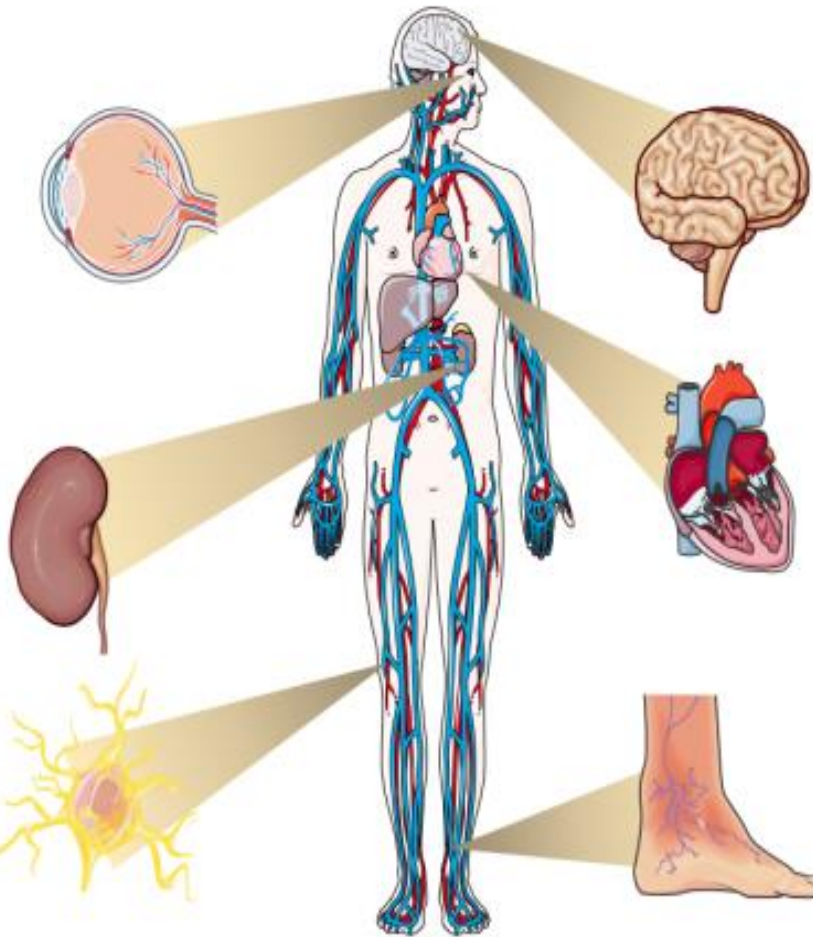
High blood glucose and high blood pressure can damage eye blood vessels, causing retinopathy, cataracts and glaucoma

Kidney

High blood pressure damages small blood vessels and excess blood glucose overworks the kidneys, resulting in nephropathy.

Neuropathy

Hyperglycemia damages nerves in the peripheral nervous system. This may result in pain and/or numbness. Feet wounds may go undetected, get infected and lead to gangrene.



Macrovascular

Brain

Increased risk of stroke and cerebrovascular disease, including transient ischemic attack, cognitive impairment, etc.

Heart

High blood pressure and insulin resistance increase risk of coronary heart disease

Extremities

Peripheral vascular disease results from narrowing of blood vessels increasing the risk for reduced or lack of blood flow in legs. Feet wounds are likely to heal slowly contributing to gangrene and other complications.

Combined Lesion

- Septic lesion
- Neuropathic lesion
- Vascular lesion: Diabetic vascular lesion
 - Atherosclerosis
 - Increased Cholesterol
- Diabetic factors affecting healing
 - Diabetic Gangrene
 - Non healing ulcer.



Grade IV: partial gangrene



Ulcer with lymphedema





Surgical management of infection

- Conservative Approach
- To reduce focus of infection –

- Drainage of abscess
- Amputation

Conservative level

Line of demarcation not well

Guillotine amputation

Stroke – Gritti's operation

Silber's technique

Infection controlled

- Planned surgery Healing of ulcer , Skin grafting

Management

- 1) Switch over to crystalline insulin
- 2) Aggressive management of infection
 - Vicious cycle of infection and insulin.
 - Insulin requirement goes down
decreases infection
 - Insulin adm. Titrating urine/
blood sugar daily
 - Hypoglycemia more dangerous than
hyperglycemia
 - More diabetic die of hypoglycemia.

D.M AND SURGERY

Surgical conditions produced or aggravated in Diabetes mellitus

Surgical conditions modified in DM

Diabetes mellitus producing diagnostic problems

Surgery in Diabetics

Surgery for relief of Diabetes Mellitus

Surgical conditions modified by D .M.

- ◉ Boil,
- ◉ Carbuncle,
- ◉ Osteoporosis,
- ◉ Perinephric abscess,
- ◉ Gall stones,
- ◉ Acute appendicitis,
- ◉ Koch's

Surgical conditions modified by Diabetes

- ◉ Boil, Carbuncles Take serious form
- ◉ Acute Appendicitis Fulminant form
 brief acute phase no signs Masked.
 Perforation, Diabetic Ketoacidosis
- ◉ Gall Stones More common , cholesterol high
 Acute cholecystitis, fatal perforation
- ◉ Osteoporosis
 - -ve nitrogen balance
 - convulsion
 - Fractures,
 - Delayed union
- ◉ Tuberculosis Resistant

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D M producing diagnostic problems

● Diabetic Abdomen

- It is a syndrome complex characterized by severe pain, diffuse, indefinite vomiting etc. in absence of any abdominal pathology.
- It may be one of the presentations of diabetic keto-acidosis
- Unwarranted Surgery High mortality

Acute Abdomen in known diabetic

- Fever + or
- Leucocytosis + or
- Pattern: Pain
Vomiting –Fever
- Pain +
over inflamed
viscous
- G.C. : Not bad

Diabetic Abdomen

Usually febrile
Increased
Fever, Vomiting., Pain

Diffuse-indefinite

Disproportionate G.C.
to abdominal findings.

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Surgery and Diabetes mellitus

- Known diabetic undergoing surgery
- Emergency surgery in Diabetic Ketoacidosis.
- D M detected in post-operative period

Diabetes and Surgery

- ◉ General Anesthesia suppresses endogenous insulin secretion
- ◉ Vasoactive substances can exert anti-insulin effects
- ◉ In DM, insulinopenia leads to hyperglycemia, increased osmolality, hypovolemia, abnormal electrolytes, and in extreme DKA or
- ◉ Hyper Osmolar Non Ketotic Acidosis

Diabetes and Surgery

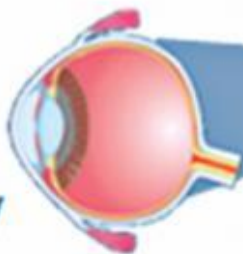
- Other concerns beyond insulin:

- Coronary Artery Disease
- Autonomic neuropathy
- Peripheral neuropathy
- Diabetic nephropathy
- Wound healing
- Infections

Complications of Diabetes

Diabetic Retinopathy

Leading cause of blindness in adults^{1,2}



Stroke

2- to 4-fold increase in cardiovascular mortality and stroke⁵



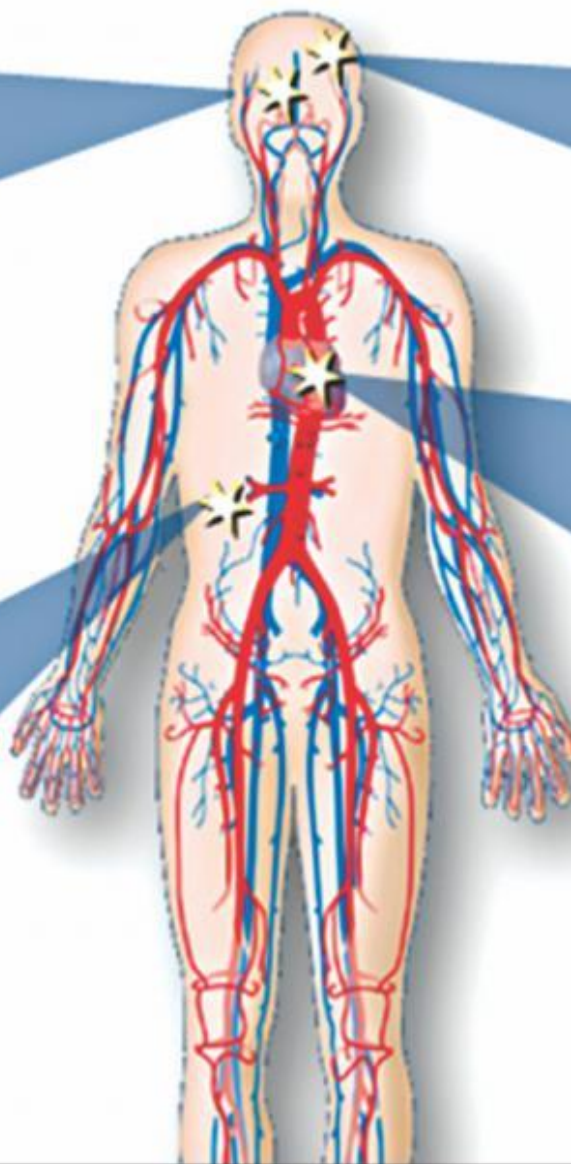
8/10 individuals with diabetes die from CV events⁶

Diabetic Neuropathy



Diabetic Nephropathy

Leading cause of end-stage renal disease^{3,4}



Known Diabetic undergoing planned Surgery

- ❖ General Principles:
- ❖ Surgical stress & strain-
- ❖ **Glucocorticoids**
- ❖ **Hyperglycemia**
- ❖ Starvation
- ❖ **Acidosis**
- ❖ Ketoacidosis
- ❖ Anesthesia factors
 - Chloroform; Ether-Increases 10-50mg CHO (No more used)
 - Ketamine also increases BSL
- Trichlorethylene (No more used) , Halothane safe
- Propofol and Pentothal ,
- Isoflurane, sevoflurane and Desflurane used and safe
- ❖ Additional coronary-cerebral, renal pathology
 - ❖ Increased incidence of thrombophlebitis,
 - ❖ pulmonary embolism, pulmonary edema

Poor healing in diabetes

- ◉ Presence of excess glucose in wound
 - Proliferation of micro-organism
- ◉ Phagocytic power of PMNL decreases complement
- ◉ Blood supply micro angiopathy
 ↓
 Atherosclerosis
- ◉ Nerve Supply Vasomotor Tone
- ◉ Supply of Insulin essential for healing

Spectrum of Oral Hypoglycaemic Agents

Biguanides

Metformin (Biguanides)

Sulphonylureas

Glibenclemide, Gliclazide

Glipizide, Glimepiride

α -Glucosidase inhibitors

Acarbose

Meglitinides

Repaglinide, Nateglinide

Thiazolidinediones

Rosiglitazone , Pioglitazone

Gliptins (DPP4 inhibitors)

Sitagliptin, Vildagliptin

Oral Hypoglycemic Agents the need to continue.....

**Metformin.....traditional phobia of lactic acidosis:
some stop 48 hours before any surgery.
Definitely: septic state, hypotension,
Renal or any major organ failure.
No increased risk if hypoglycemia when used alone.**

**Sulphonylureas/ Meglitinides
Thiazolidinediones.....May be continued.**

Oral Hypoglycemic Agents

Acarbose: Avoid due to GI side effects

DPP4 inhibitors: Avoid on the day of surgery because of delayed gastric emptying

Known diabetic undergoing planned surgery

Previous Treatment

Minor

Major

- ◉ Diet

Observe

Observe. May need insulin P.O.

- ◉ Oral

) Withheld
) until surgery

Switch over to cry. Insulin

- ◉ Insulin

)

-do----

- ◉ >140 mg Insulin in drip

- ◉ <100 mg I.V. Dextrose

Known Diabetic

Undergoing planned Surgery

- ◉ Take it seriously
- ◉ Admit one week prior to surgery
- ◉ Assess his diabetic status
- ◉ Glycosylated Hemoglobin
- ◉ Controlled at least two days prior
- ◉ Assessment of cardiac, pulmonary, cerebral and renal status
- ◉ After control, Insulin management depending upon magnitude of surgery

The **Alberti regimen**

- Infusion of a premixed bag of glucose–insulin–potassium for the metabolic management of diabetic patients in the perioperative period.
- The **Alberti regimen** has been superseded in many centres by the use of separate infusions of insulin (usually 1 U ml⁻¹) and glucose with or without potassium.

Known Diabetic undergoing elective surgery

● On Day of Surgery

1. Fasting blood sugar, Urine sugar, basal data
2. No breakfast and morning dose of insulin
3. Deserves to be taken as first case.
4. To avoid starvation, ketoacidosis IV drip 5% Dextrose with $1/3^{\text{rd}}$ dose of total insulin daily requirement
5. Intra operative second $1/3^{\text{rd}}$ dose of insulin
6. Omit remaining $1/3^{\text{rd}}$ dose
7. Post operatively insulin if required by titration method.

Postoperative Management - Insulin

- Restart insulin at modified dose if required
- Supplement with SC sliding scale with meals
- For patient on IV insulin, continue until eating well and ensure overlap with SC insulin
- Never leave Type 1 DM without insulin –
risk for Diabetic Keto Acidosis

SLIDING SCALE REGIMEN S/C



Glucose in mg/dl	Regular Insulin S/C
150-200	2 unit
201-250	4 unit
251-300	6 unit
301-350	8 unit
≥350	10 unit

VELLORE REGIMEN

- All patients had blood glucose measured at 6 am.
- For those patients whose operation started in the morning (7:30 am), no glucose or insulin was given in the ward.
- All other patients receive a glucose insulin infusion in the ward, if their blood glucose is more than 100 mg/dL.
- Regular insulin 5 U in 500 mL of 5% dextrose in water solution (D5W) was started in the ward at 8 am @ 100 mL/hr until the time of operation.

VELLORE REGIMEN

Blood sugar (mg/dL)	Treatment
<70	Stop insulin if on insulin. Rapid infusion of 100 mL of D5W, measure blood glucose after 15 min
71-100	Stop insulin, infuse D5W at 100mL/h
101-150	1U of insulin + 100 mL of D5W/h
151-200	2U of insulin + 100 mL of D5W/h
201-250	3U of insulin + 100 mL of D5W/h
251-300	4U of insulin + 100 mL of D5W/h
>300	1U of insulin for every 1-50 mg more than 100 mg/dL + 100 ml of normal saline/h

Postoperative Management – Oral Hypoglycemic Agents

● Metformin

- Contraindicated in severe renal impairment
- Avoid in conjunction with IV contrast

● Sulfonylureas

- Can induce sig and prolonged hypoglycemia
- Avoid or modify in erratic or poor PO intake
- Deterioration in renal function can increase risk of hypoglycemia

● Thiazolidinediones

- Associated with fluid retention
- Avoid in advanced CHF

Emergency Surgery in Diabetics

- May be in Diabetic Ketoacidosis
- May be in diabetic abdomen.
 - -Ultrasound) to confirm
 - CT Scan) Abd. Pathology.
- Control of D.M. by titration method
- Minimal surgery
- Optimal anesthesia management
- Optimal post-operative care.

Diabetes Mellitus detected post operatively

When to suspect:

1. Early : Failure to come out of anesthesia
Diabetic ketoacidosis
Unexplained hypotension
2. Late : Septicemia
Increased infection
Non healing of wound.

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Surgery for relief of Diabetes Mellitus

- Secondary Diabetes: Treat the cause
 - Adrenalectomy
 - Hypophysectomy
- Chronic pancreatitis: Drainage procedure
- Primary Diabetes:
 - Islet cell of Langerhans transplant
 - Foetal pancreatic transplant
 - Total pancreatic transplant
 - Neoprene treated pancreatic transplant.
- Metabolic Surgery

Metabolic surgery



Roux-en-Y Gastric Bypass



Vertical Sleeve Gastrectomy

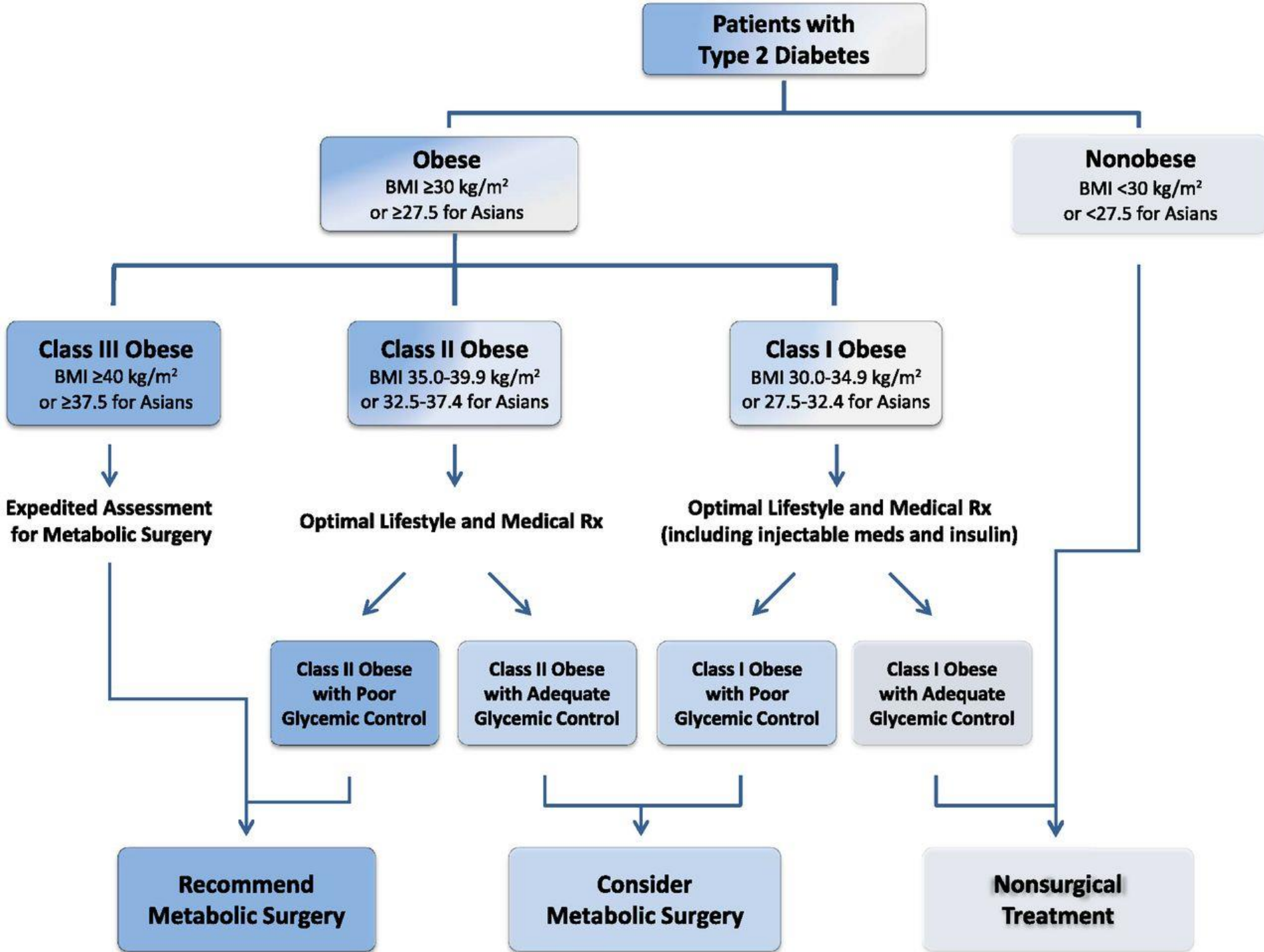


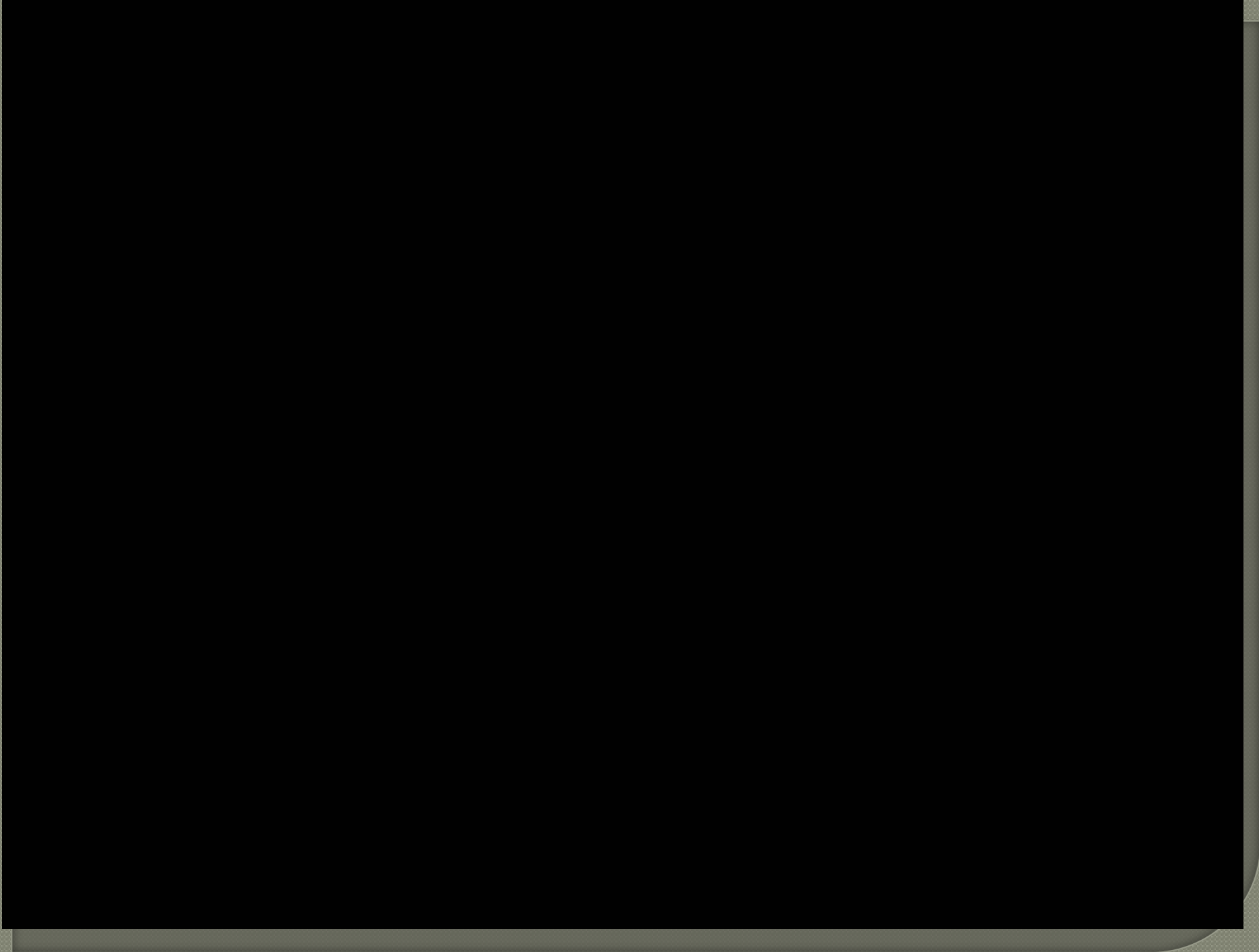
Laparoscopic Adjustable Gastric Banding



Biliopancreatic Diversion

Diagrams of the four bariatric/metabolic operations currently in common clinical use. BPD can be performed as the classic type (shown) or with the duodenal switch variant.









Thank You!