

RESPIRATORY BLOCK

Biochemistry Team ~ 430

1st Lecture

Phospholipids Compounds of
Physiological Importance

with ALL my notes

I did my very best ,, hope

everything is clear

HAPPY STUDYING! 😊

Done By :

روابي الجميلة

أمجاد بني علي .. لمى الجمعة

الهنوف الخلف .. عائشة جابر

هاشم المحمود .. عبدالعزيز المنيع

عزام القشعمي .. عادل الرشيد

• **Background: Lipid Compounds :**

- ✗ **Heterogeneous group (means different structures)**
- ✗ **Relatively water-insoluble (? Exception)**
- ✗ **Soluble in non-polar solvents**

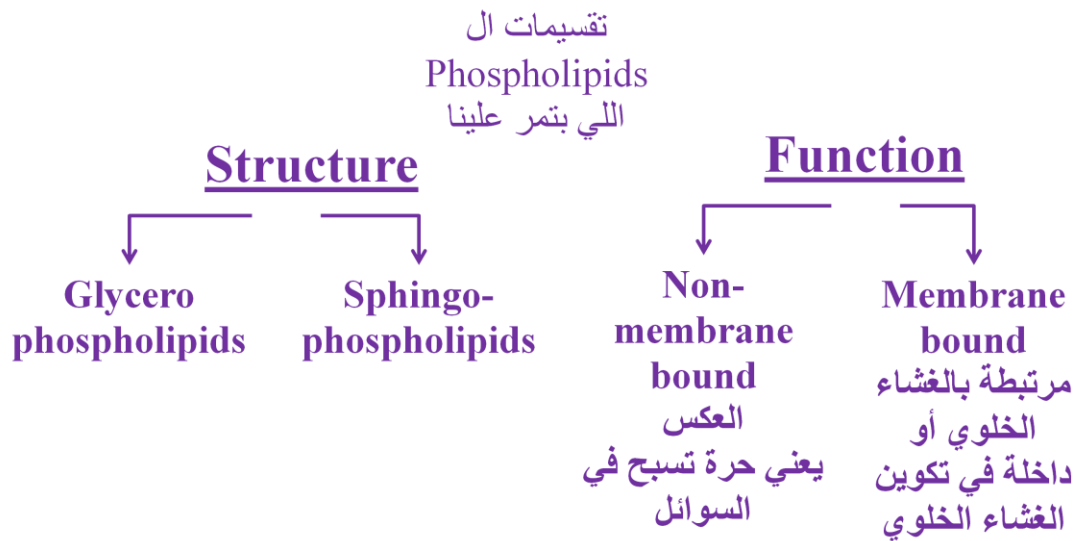
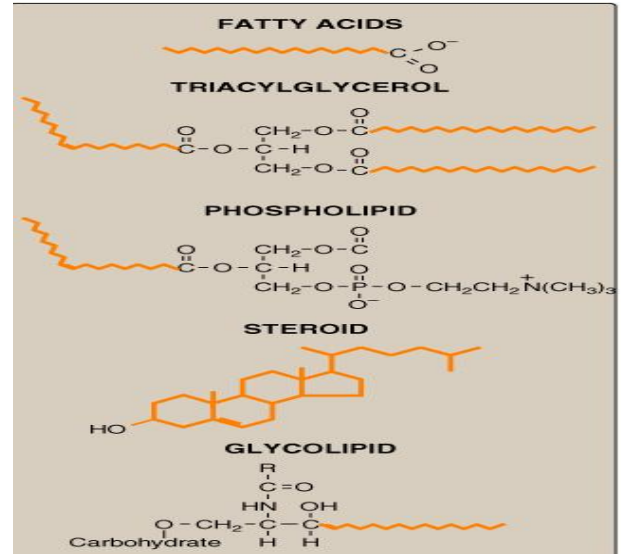
• **Lipid Compounds: Heterogeneous Group**

A. Simple Lipids:

- Fatty acids
- Ketone bodies (soluble in water)
- Triacylglycerol
- Cholesterol

B. Complex Lipids:

- Phospholipids
- Lipoproteins
- Glycolipids



و حنا في الدرس بنأخذ بس ٣ مواد مهمة دخل في تركيبها الـ *phospholipids* :
 وكلها *non membrane bound (Surfactant , Platelet-activating factor)*

إلا واحد وهو The COVERING or coat of lipoprotein

- **Functions of Phospholipids:**

- **Membrane-bound phospholipids:**

Structural : Predominant lipids of cell membranes

Anchoring : Attaching some proteins to membranes

Signaling : Source of PI3 and DAG

Myelin sheath : insulator and speeds up transmission of nerve impulses

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- **Non-membrane-bound phospholipids:**

Easy re-inflation of alveoli by air: Lung surfactant

Detergent effect: Essential component of bile

Solubilize cholesterol ,preventing gall stones

Emulsifying lipids , helping lipid digestion

Structural: Coat of lipoproteins

Bioactive molecule: Platelet-activating factor (PAF)

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- **Phospholipids:**

- 1- **Glycerophospholipids**

Glycerol-containing phospholipids

- 2- **Sphingo-phospholipids:**

Sphingosine-containing phospholipids

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- **Phospholipids: 1- Glycerophospholipids :**

- **Parent Compound** المصدر والاساس :

Phosphatidic acid

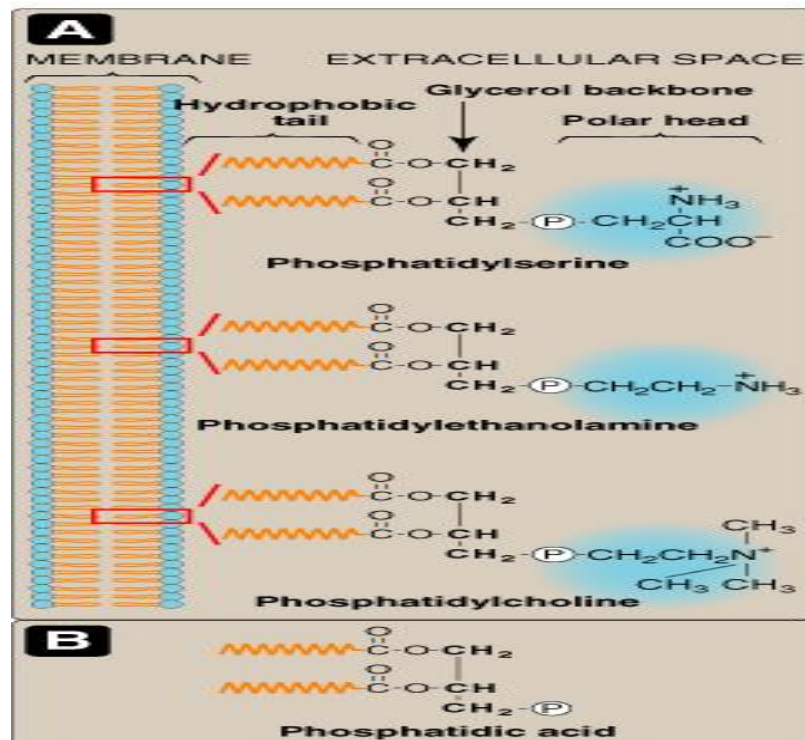
- **Members:**

1- **Phosphatidylcholine (Lecithin)** e.g., Surfactant (Dipalmitoylecithin)

2- **Phosphatidylinositol** (Signaling and anchoring molecule)

3- **Platelet-activating factor (PAF)** (Bioactive molecule)

--Members: 1- Phosphatidylcholine (Lecithin)
e.g., Surfactant (Dipalmitoylecithin)

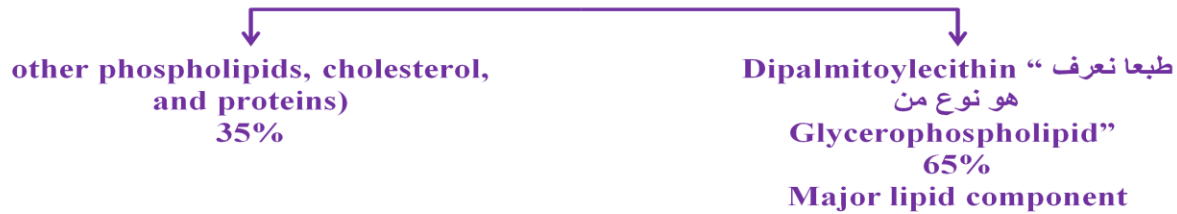


-- Dipalmitoylecithin (Lung surfactant):

- Dipalmitoylecithin is the major lipid component of lung surfactant (65% of surfactant components)
- The remaining 35% is composed of other phospholipids, cholesterol, and proteins)
- It is synthesized & secreted by granular pneumocytes
- The surfactant ↓ surface tension of fluid layer lining of alveoli → ↓ the pressure needed for their inflation by air → prevention of alveolar collapse (atelectasis)

** the words in red are more organized in the next ☺

Surfactant Is made up of



Function of surfactant:

- 1- Surfactant becomes scattered between the air and water layer of the alveolus.
- 2- Decreases the surface tension
- 3- Decrease the amount of pressure needed to inflate the alveolus
- 4- Finally , we could say that its importance is to prevent the alveolus from collapsing (atelectasis)

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• *Congenital Respiratory distress syndrome (RDS):*

- **CONGENITAL** “at birth” RDS is the insufficient *production of lung surfactant (especially in pre-term babies)* → *(this might lead to neonatal death)*
- **In adults** its (required) (adult respiratory distress syndrome) **caused by** smoking or hypoxia leads to the decrease **SECRETION** of surfactant.
- **Prenatal diagnosis by:** Lecithin/sphingomyelin ratio (L/S) in amniotic fluid
طبيب كيف نعرف؟؟

Steps:

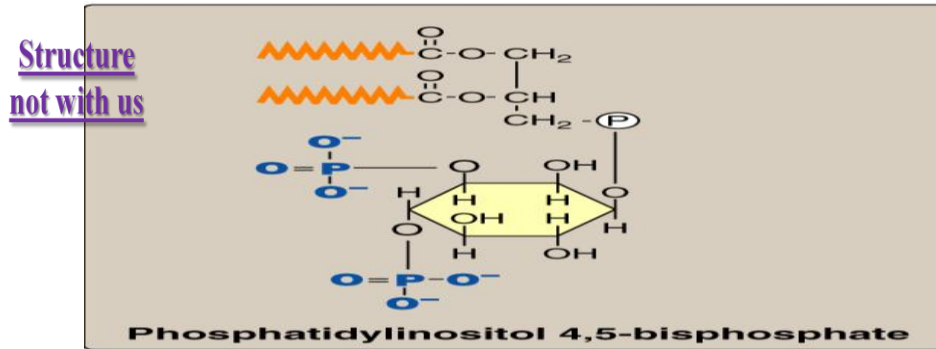
- 1- they take a a sample from the amniotic fluid *after the 32 week of gestation (to carry in the womb)*
- 2- check the ratio (percentage) of (L/S) , it HAS to be 2 OR MORE!!!!
(which indicates that the production shifted from sphingomyelin (type of lipid WE DON'T NEED in synthesizing surfactant) to lecithin synthesis (type of lipid WE NEED in synthesizing surfactant) by pneumocytes (type 2 alveolar cells) that normally occurs by 32 weeks .
- 3- and if the ratio is LESS than 2 ,, then we know that the baby is going to have RDS!
- **Prevention:** Glucocorticoids to the pregnant mother
with low L/S ratio shortly before delivery
- **Treatment:**
Intratracheal administration of surfactant to pre-term infants with RDS

This treatment is demonstrated IF !!!

*The glucocorticoids DID NOT! Do its job (which is **حفر**ing the production of surfactant) .. Cool? ☺*

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--Members: 2- Phosphatidylinositol 4,5 biphosphate (PI)



• PI - Protein Anchoring :

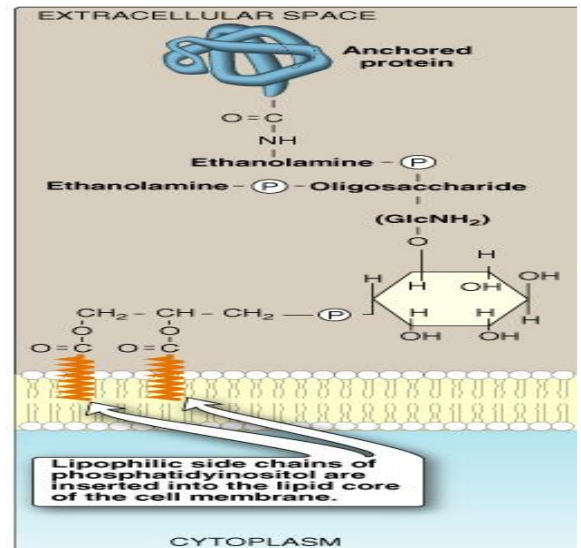
-- Anchoring of proteins to membranes via Carbohydrate-Phosphatidylinositol (type of Glycerophospholipid) bridge

Anchoring تعني :

انه يربط و يوصل البروتين بالغلاف بس ما يحد من حركة البروتين (يعني باقي البروتين يسبح في السائل ويتحرك حركة حرة بس ممسوك مع جهة و هنا أتذكر قالت HUGE importance ☺ و الحكمة عشان إذا احتاج البروتين ينفصل ينفك بسرعة

• Examples of anchored proteins:

- 1- Alkaline phosphatase :
(to the surface of small intestine)
- 2- Acetylcholine esterase
(to postsynaptic membrane)



These proteins can be cleaved from their attachment to the membranes by phospholipase C

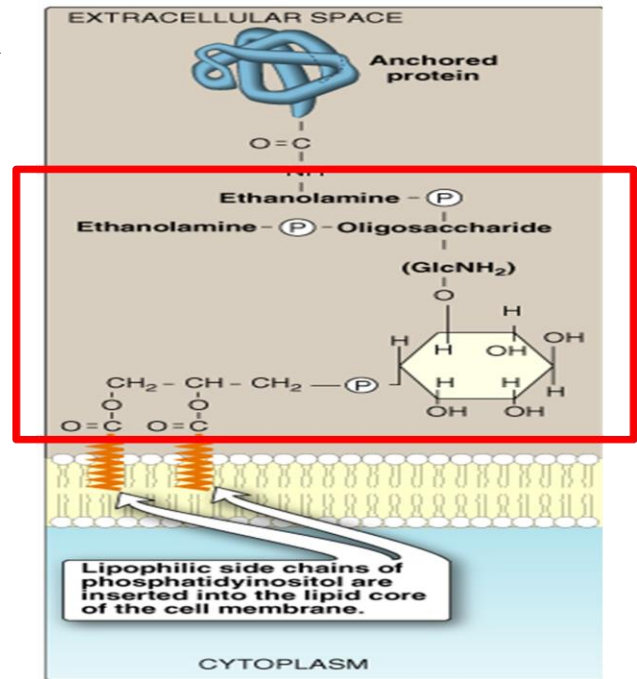
That is the **Carbohydrate-Phosphatidylinositol bridge**

That **ANCHORES** the protein to the membrane.

Did you ask yourself why? Why do the protein needs something to attach it the the membrane?

Because it can't attach by its self

Now how smart is that people ☺



--Members 3- Platelet-activating factor (PAF)

Potent (low amount can cause huge harm)

bioactive molecule produces

its effects at very low concentrations

رقم مو مهم بس المعلومة جدا مهمة (10-12 mol/L)

■ It mediates (يؤجه التالي):

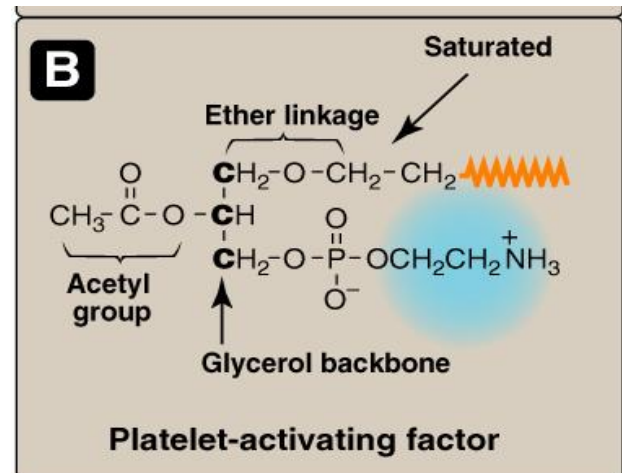
Acute inflammatory reactions

Hypersensitivity and anaphylactic reactions

(which means allergy and we are going to take it in details in immunology so don't worry ☺)

■ It stimulates (يحفز التالي):

Platelet aggregation and degranulation Neutrophils & alveolar macrophages to generate superoxide radicals as an antibacterial defense mechanism



• **Phospholipids: 2- Sphingo-phospholipids:**

Sphingosine-containing phospholipids:

e.g., sphingomyelin (Myelin sheath)

She said not so important cause we are going to take it in CNS block she said just know the name and the main structures of it

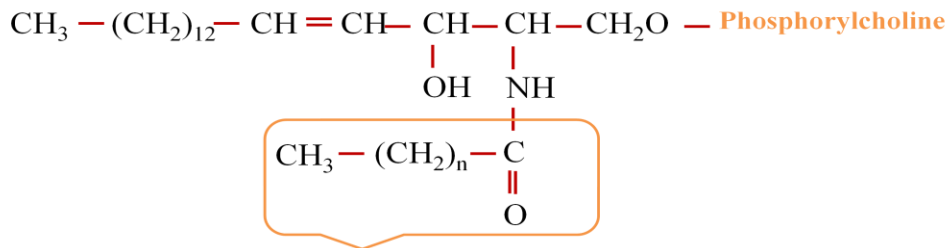
1- Long chain, unsaturated amino alcohol

2- Long Chain Fatty acid

That's all and In the two box below not important

■ **Phospholipids: B. Sphingo-phospholipids :**

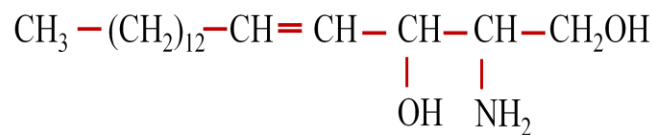
Sphingomyelin



Long Chain Fatty acid

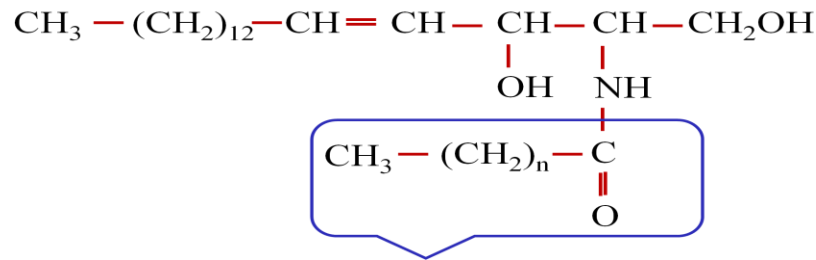
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■ **Sphingosine :**



Long chain, unsaturated amino alcohol

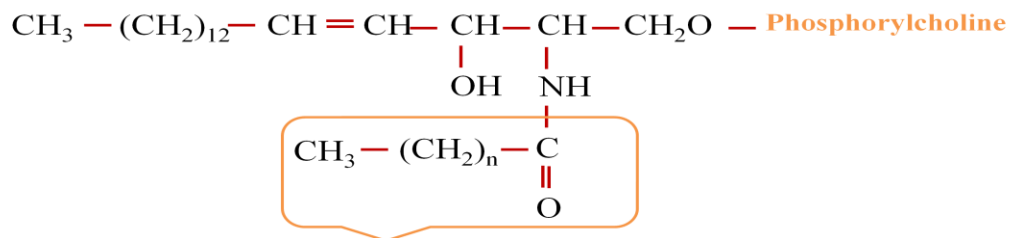
■ **Ceramide: Parent Sphingolipid Compound:**



Long Chain Fatty acid

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■ **Sphingomyelin:**



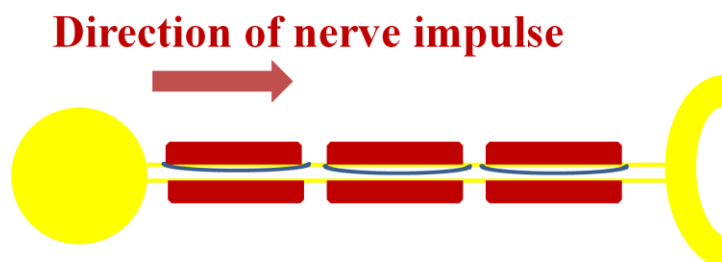
Long Chain Fatty acid

• **Function of Myelin Sheath:**

Myelin structure: 1- Lipids (80%) ↗ Glycolipids (mainly)
↘ Sphingomyelin
 2 -Proteins (20%)

Myelin sheath insulates the nerve axon to avoid signal leakage and greatly speeds up the transmission of impulses along axons

في العادة يكون اللبد اقل من البروتين لكن في المايلين عكس ذلك



• Lipoprotein Structure:

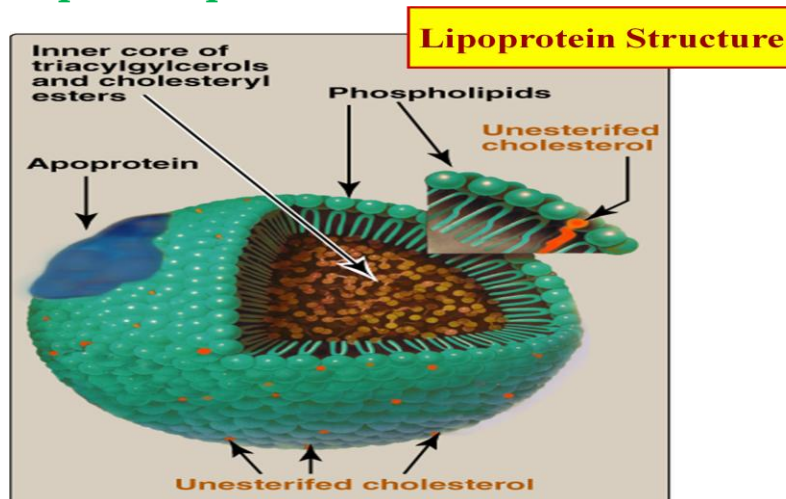
-- Outer part (coat):

- Apoproteins or apolipoproteins
- Phospholipids (Why?)
- Free cholesterol

(Relatively hydrophilic, allowing transport of lipid particles of the core in the aqueous plasma)

-- Inner part (core):

- According to the type of lipoproteins
- Different lipid components in various combinations



Alright,, so *لش قصة* lipoprotein

It can NOT move or swim in the aqueous fluid (plasma) easily because its NOT soluble in water and the plasma is mostly water,, right?

So, Allah *خلق* a cover or a coat around it to help it become soluble (not 100%! But partially)

And this cover has in it **PHOSPHOLIPID** which is the most important thing and what our lecture is about.

Okay now,, why??? Why phospholipids?

Well , like we all know the the phospholipids have a hydroPHILIC head and hydroPHOBIC tail

So by that it is PARTIALLY soluble in water,, and helps the lipoprotein swim comfortably in the plasma Cool ? ☺

سبحان الله

Take Home Message

- *Phospholipids are Complex lipids*
- *Phospholipids have important physiological functions:*

A. Membrane-bound:

Structural

Signalling & anchoring: e.g., PI

Myelin sheath: e.g., sphingomyelin

B. Non-membrane bound:

Structural: Lipoprotein coat

Alveolar re-inflation: Lung surfactant

Inflammation & hypersensitivity: PAF

Platelet aggregation & defense: PAF

Detergent effect: Phospholipids of bile

THANK YOU