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Role of *Kapha Dosha* in Cell Membrane Biogenesis and Transport across Cell Membrane

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ABSTRACT

Cell is the basic or smallest functional unit of life. Each cell is working and the together result of that is the alive whole body. This article will be focusing on the very crucial process happening across the cell membrane i.e transport of substances in and out of cell. This study had established the facts for the importance of kapha dosha in cell biogenesis and transport across cell membrane. Initially definition and introduction kapha dosha has been explained. Also the cell membrane structure has been explained. Source of information has been gathered from research articles, reputed textbooks and medical websites. Ayurvedic concepts are searched in ancient textbooks like charak samhita, sushrut samhita and ashtang hridya. A strong correlation has been established between the modern concepts of cell membrane biogenesis and transport across the cell with the basic principles of ayurveda.

Key Words

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INTRODUCTION

What is kapha dosha?

"Slishalinge" – The one which binds two or more than two elements together is kapha[1].

Its properties explained by Archarya Charak as- "*gurusheetsnigdhamadhurpichila".*

which means it is heavy, cool, oily, sweet and sticky in nature. This definition and these properties will help us to relate it with the organelles of cell or with structure of cell membrane.

General structure of cell membrane-

Cell is the smallest unit of life[2]. It is having many working organelles which are performing their functions to keep cell alive and healthy. Basically cell is composed of three basic macro-nutrients- protein, carbohydrate and fat[3]. Whole cell is filled with fluid and also surrounded by fluid. It is like a bag of fluid floating in fluid.

Cell membrane is a structure which makes the boundary of cell, containing every other cell organelles and fluid. So cell membrane holds all the content of cell. It is like a wall. Cell membrane is composed of phospholipids, proteins, cholesterol and some carbohydrates[4].

The phospholipids have two part- one hydrophobic and other hydrophilic, hydrophobic is the lipid part whereas hydrophilic is the

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phosphate part. As it is a bilayer both hydrophobic are oriented towards each other and hydrophilic opposite to each other. In between these phospholipids cholesterol bodies are also present[5].

The characteristic feature of lipid layer is that, it is fluid in nature and not a solid structure. So, the portions of the membrane move from one point to another point along the surface of the cell. The materials dissolved in lipid layer also move to all the areas of the cell membrane. The major lipids are: 1. Phospholipids 2. Cholesterol.

1. Phospholipids

The phospholipids are the lipid substances containing phosphorus and fatty acids. The phospholipids of the lipid layer are amino phospholipids, sphingomyelins, phos phatidyl choline, phosphatidyl etholamine, phosphatidyl glycerol, phosphatidyl serine and phosphatidyl inositol. Each phospholipid molecule resembles the headed pin in shape. The outer part of the phospholipid molecule is called head portion and the inner portion is called tail portion. The head portion is the polar end and it is soluble in water and has strong affinity for water (hydrophilic). The tail portion is nonpolar end. It is insoluble in water and repelled by water (hydrophobic). The two layers of phospholipids are arranged in such a way that the hydrophobic tail portions meet in the center of the membrane. The hydrophilic head portions of outer layer face the ECF and those of the inner layer face the ICF (cytoplasm).

2. Cholesterol

The cholesterol molecules are arranged in between the phospholipid molecules. The phospholipids are soft and oily structures, and cholesterol helps to "pack" the phospholipids in the membrane. So, cholesterol is responsible for the structural integrity of lipid layer of the cell membrane[6].

The cell membrane is normally having fluidity property. It floats in fluid sideways which explains its fluidity. This fluidity is responsible for much transport between inside and outside cell.

Importance of fluidity of cell membrane-

Cell membrane fluidity is important for several important reasons. First, cell membrane fluidity is vital to membrane function and must be regulated and maintained to allow membrane proteins and lipids to diffuse through the bilayer. These proteins and lipids can enter or exit the cell membrane depending on the components of the cell membrane and are essential for synthesis of other nutrient molecules and pathways of the cell. **Cell membrane fluidity is also important and maintained** because it is vital to the fusion of membranes together and also allows membrane distribution to be split evenly during cytokinesis and cell division. **When the cell membrane is too rigid and not fluid**, this decreased membrane fluidity can negatively impact transport along the cell membrane and also break under the pressure of the body, such as high blood pressure in arteries. **When the cell membrane is too fluid**, this increased membrane fluidity can also negatively impact the cell. The

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cell would be more prone to breaking as well, due to the instability of the cell membrane. The cell won't keep its shape properly! T**herefore, cell membrane fluidity is very important to the homeostasis of the cell and our bodies' health**[7]**.** *The term Biogenesis refers to "Life From Life"*[8]*. Cell biogenesis is the regeneration of components of cell by itself. It is fluidity one of the factor on which cell membrane biogenesis and transport across membrane hugely depends.*

When cells needs to replace the dead or impaired portion of cell membrane it forms the new part of that area and send it to damaged portion, because of the fluidity and flexibility of cell membrane new part replaces the old one easily and flush them or throw them out in the extracellular environment, but if the membrane is stiff and has much reduced in its fluidity it would be difficult for the cell to refurbish the cell membrane.

Factors affecting fluidity of cell membrane-[9] **(See table no. 1)**

1. Length of tail of phospholipid
2. Amount of cholesterol present in phospholipid bilayer
3. Temperature
4. Saturation of fatty acids
5. **Signs of kapha dhatu vridhi-**
6. White coloration, Cold, Stability, Feeling of heaviness, Debility, Stupor, Sleep Looseness of joints, debility of digestive activity, excess salivation, lassitude, feeling of heavy white colouration (of faeces etc.), coldness, looseness of the body parts[10,11].
7. **Signs of kapha dosha kshay-**
8. Dizziness, emptiness of the organs of kapha, tremors of heart and looseness of joints. Dryness, burning sensation inside, emptiness especiall in amashay and other seats of kapha[12,13].

Table 1 Factors affecting fluidity of cell membrane

Increase Fluidity	**Decrease Fluidity**
Phospholipids with Shorter Tail Lengths	Phospholipids with Longer Tail Lengths
More Double Bonds (Unsaturated)	Fewer Double Bonds
Less Cholesterol	More Cholesterol (generally in high temperatures)
Less Packed Together	Closer Together/ More Packed together
High Temperature	Low Temperature
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Molecular weight-

amino acid the smallest unit of protein is having molecular weight from 75 to 204 g/mol[14.]

Saturated fatty acid is having molecular weight of 386 g/mol[15].

Carbohydrates having molecular weight around 180 g/mol[16].

Samanya vishesh siddhant-

As per this concept of ayurveda explained in charak sutra sthan chapter 01 that similarity is responsible for the increase in quantity of item and dissimilarity reduces the same.

DISCUSSION

With above knowledge many facts could be established and a quality comparative link could be established between principles of ayurveda

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and modern knowledge. This study is pointing towards a very clear insight that kapha dosha has very much importance in transport across cell membrane and also in cell membrane biogenesis.

Now this is pretty much clear transport across cell membrane and cell biogenesis is hugely affected by fluidity of cell membrane, whether it is exocytosis, endocytosis, cell wall repairement, transport through trans membrane protein, movement of cell membrane across the cell organelles, every such event is affected by fluidity of cell membrane. Too less fluidity will hamper the transport due to stiffness and closely packed phospholipids and cholesterol and too high fluidity will be disturbing or destroying the integrity of cell, this could also lead to cell lysis or breakdown of cell.

Maximum portion of cell membrane I made up of phospholipids, faty acids and cholesterol which are different derivatives of fat. Kapha dosha is having much similarity with fat. Any change in the quality or quantity of kapha will directly affect fat in the body. With the principle of *Samanya-vishesh-siddhant* increase in kapha will increase fat also or decrease in kapha dosha will decrease fat also. Properties similar in kapha dosha and fat are *snighata, guruta, sheetta, pichilta, sthirta.*

Kapha dosha with its properties, directly affects the fluidity of cell membrane. Kapha with its snigdha guna maintain the fluidity in lipid layer of cell membrane.

Temperature is one of the very important factor affecting fluidity of cell membrane, it is directly proportional to fluidity of cell membrane. Kapha dosha has sheeta guna i.e cold in nature, so increase in kapha will decrease the fluidity of cell membrane as it decreases temperature.

Another guna of kapha is pichchli i.e sticky, cholesterol is having the same sticky property, increase in cholesterol will reduce the fluidity of cell membrane and with samanya vishesh sidhant khapa dosha will increase cholesterol due to its pichchil guna.

Guru is the another property of cell membrane, means heavy. Fat is having higher molecular weight than all other macronutrients forming cell membrane. Increase in kapha dosha will affect the guru guna and hence could increase the fatty acid saturation and cholesterol amount also. Which will again reduces the fluidity of cell membrane.

Same way, decrease in kapha dosha will destroy the integrity of cell as it will directly affect the cell membrane which is made up of phospholipid and cholesterol mainly. Reduction in kapha will reduce these elements also and hence the membrane which is keeping up the cell organelles together and was working as a holding bag will get disrupted and cell goes to breakdown.

CONCLUSION

With this study this is concluded that kapha dosha has very much similarities with the factor maintain the integrity of cell membrane and the factor responsible for transport across cell

membrane and foe cell biogenesis. Kapha dosha directly affect the structures or process in which fat is involved.

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