Basic science of cell biology and biochemistry

Basic research in biology and biochemistry shows us the structure of cell membranes. These are bilayers made from phosphatidylcholine molecules. Phosphatidylcholine consists of a hydrophilic group on one end and hydrophobic fatty acids on the other end.

Phosphatidylcholine is one of the most important phospholipids (PPL), which are important components of all cellular and subcellular membranes. They ensure a normal membrane structure and thereby the numerous functions of the cell. PPL represent the matrix of all biological membranes.

Depending on the kind of cell, the phospholipid content and composition is different. In the liver cell for example the membrane consists of 65% PPL. Of these 80-90% is Phosphatidylcholine. Embedded in these Phospholipid Bilayer are structural proteins, that function as receptors for neurotransmitters, hormones, peptides, antigens, antibodies and many more. The more functions a cell membrane must fulfill, the more specific proteins it must contain. Most of the membrane proteins need phospholipids for their biological activity. Phospholipids activate membrane bound enzymes: Adenylyl cyclase, Na/K-ATPase, Ca-ATPase, Phosphorylase, Lipoprotein lipase and others. Phospholipids regulate many different processes of metabolism between the intracellular and extracellular matrix. PPL are also important for the synthesis of prostaglandins from Eicosatrienacid and Arachidonic acid, that are made from linolic acid. Prostaglandins are cytoprotective(2). Newer research shows that phosphatidylcholine has significant antioxidant properties.

Conclusion: PPL – in particular Cholin-PPL are indispensable for the regeneration and formation of biological membranes. The functionality of all cellular and subcellular membrane systems is dependent on the integrity of the phospholipid structure.

The body’s own synthesis of PPL declines with increasing age. Then there is the addition of endothelium damaging influences such as free radicals, detergents (dissolve the phosphatidylcholine from the membrane), inflammation, allergies, immunological processes, metabolic diseases, toxic substances, heavy metals and not to mention the mechanical damage done by angioplasty.

The consequences of this chronic damaging are defective cell membrane structures. This in turn leads to: - Impeded transport of substances through the cell membrane
  - disturbed enzyme function (disturbs energy provision)
  - inactivated, destroyed, mutated receptors
  - disturbed organ function
  - release of oxidated LDL cholesterol (leads to weakend membrane stability and increased serum LDL)
  - scar tissue
  - plaque formation
  - elevated homocystein levels

The mechanism of effect of PPL is: (as example in the liver cell (2), (10).)
1. Stability ↑ against Viruses, Toxins, Noxen
2. Cell protection ↑ (free radicals ↓, Lipidperoxidation ↓)
3. Physiology (Fluidity, Elasticity, Flexibility, Rigidity, Permeability, Enzyme & Proteinactivation, Prostaglandines)

4. Regeneration (energy laden Elements, RNS-Synthesis, Livercellglykogen)

5. Immunology (ADCC, MILT)

ADCC: Antibody dependent, cell mediated cyto toxicity, MILT: Mitogenic induced Lymphocytes cytotoxicity

6. Restoration of the normal membrane structure

7. Antifibrotic Effect

8. Improved lipid metabolism with formation of lipoproteins

9. Stabilisation of the gall fluid

The biochemical Pathway of Phosphatidylcholine

In vitro and in vivo effects of „essential“ phospholipids

Based on more than 15 experimental studies the important questions about pharmacokinetics of EPL could be seen as answered in 1990 (2). Many studies with intravenous application of EPL describe their influence on the lipid metabolism, formation of atherosclerosis, liver and kidney function.

In 1962 Varkony (4) wrote about the cholesterol lowering influence and the improvement of angina pectoris and claudication symptoms in EPL treated patients. 1995 Klimov (5) compared EPL with nicotinic acid in the treatment of type IIb hyperlipoproteinaemia and coronary heart disease. He ascertained, that nicotinic acid better increases HDL than EPL, but EPL-patients had a significantly improved bike ergometric capacity. Borodin et al (6) found a lower cholesterol content in erythrocyte and thrombocyte membranes in rabbits, treated intravenously with positively charged micelles from soy-phosphatidylcholine. They also found a reduced microviscosity of the cell membranes, an increased Na,K- und Ca-ATPase activity in erythrocytes and a reduced aggregation of thrombocytes, that is induced by ADP and collagen. The phospholipid contents in the serum was increased as well as cholesterol in the HDL fraction. Triglycerides and the atherogenic index were reduced. Atherosclerotic lesions of the aorta were two times less than in the control group. In the seventies animal experiments (7) showed, that EPL removed lipids, that are characteristic for atherosclerosis, from the arterial wall and promote the elimination of cholesterol esters from tissues. The incorporation of H3-marked EPL in cholesterol esters is significantly increased in atherosclerotic arteries. The H3-EPL Cholesterol esters were removed from the arterial tissue after 8 weeks of EPL treatment, as were also 14c-Acetate, 3H-Olein und 14c-Linol marked Cholesterol esters.

Pupita et al (8) treated 31 atherosclerosis patients with intravenous EPL and found a significant improvement of all pathological serum lipid values and a reduction of atherosclerotic symptoms. In 5 patients the function of the adrenal cortex was improved (ACTH test) and patients with nephrotic syndrome showed the same positive results reg. serum lipids. The tendency towards
Increased blood clotting often seen in atherosclerotic patients was normalized with EPL treatment. Adams et al (9) showed a marked plaque formation in rabbits where atherosclerosis was provoked with cholesterol feeding without treatment and with treatment with ovolecithin, but no occurrence of atheroma and fatty liver in rabbits treated with phosphatidylcholine from soy. Bowyer et al (11) checked the endocytosis rate of smooth muscle cells and epithelial cells in vitro, as the incorporation of lipids into these cells of the arterial wall is a major factor in the pathogenesis of atherosclerosis. They found that the rate of endocytosis is significantly reduced by adding phosphatidylcholine. From 1989 to 1991 Belotserkovskii et al (12) treated patients suffering from coronary heart disease with either plasma pheresis, plasmapheresis and EPL, extracorporal hemocorrection or all 3 treatments combined. The CHD improved the most in patients of the last group. Cholesterol values were only reduced in the patients receiving EPL.

The summaries of these studies are available for interested physicians from Jeunomed International Corp.

**Literature**

2. VII. Colloquium hepatologicum Halle/Saale, 16.-18.10.1990, Zeitschrift für Gastroenterologie, Sonderheft
5. Essential phospholipids versus nicotinic acid in the treatment of patients with type liib hyperlipoproteinemia and ischemic heart disease: Klimov AN et al, Cardiovasc Drugs Ther 9(6):779-84, 1995