PATHOGENIC VALUE OF ELECTRIC DISRUPTION CHANGES AND ERYTHROCYTES MEMBRANE MICROVIScosity IN CALCULOUS PYElONEPHRITIS IN CHILDREN AND WAYS OF THEIR CORRECTION

Electric disruption in erythrocyte membranes and their microviscosity were defined in 194 patients with acute suppurative form of calculous pyelonephritis (CP) in 3 weeks and in 3 months after basic or metabolic therapy. 24 practically healthy children aged from 5 to 14 years were examined as well. Electric disruption in erythrocyte membranes in practically healthy children occurred with index 135.4 mV. In patients with acute suppurative form of CP this index was 62.4 mV, in group of patients with acute serous form of CP % 73 mV, in children with latent form of CP - 78 mV. Considerable decrease of electric membrane stability resulted in 43-46% of patients with acute suppurative form of CP in bilateral numerous stones, as compared with control group. Corrected role of complex using of vitamin coenzymes, antioxidants and antiaggregants stabilizes metabolic tubular acidosis of kidneys, blockades inflammatory process activity, inhibits formation of saline sediments (phosphates, oxalates, uric acid, calcium) and normalizes ion permeability of cellular membranes.

Keywords: Calculous pyelonephritis, metabolic treatment, erythrocytes electric membrane disruption, microviscosity. 

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Introduction

Primary calcification in kidneys has pathogenetically been associated with destruction of cellular membranes of nephron tubular apparatus (Jumurovet al., 1991; Ulugmuratov, 2000; Sarica, 2006; Hoff, 2004). Advances in physical condition study of lipids and proteins in membrane, its physical and chemical properties, molecular organization of membranes became possible due to development of whole arsenal of modern physical -chemical methods. One of them is the method of measuring of erythrocytes electric membrane disruption at the expense of diffusive difference of potentials considering integral of dynamic property indicator of biological membranes characterizing microviscosity (Lev, 1979; Putvinskiy et al., 1983; Ruche and Chetvernikov, 1970; Spivacow et al., 2008; Ingram, 1969). At present, erythrocyte membranes are considered as universal model of cytoplasm membranes, their studies can be wholly extrapolated on cellular membranes of other tissues and organs (Pokrovskiy et al., 1977; Spivacow et al., 2008). Thus, the present work selected erythrocytes as model of membrane pathology to study kidney diseases in children.

High percentage of calcification recurrences and progress of pathological changes with further development of functional kidney failure, both in nearest and distant periods after operation, clearly demonstrarte many unsolved problems of urolithiasis and its complications. (Alon et al., 2004; Al-Shuhri et al., 1999; Areses et al, 2004; Borghi et al., 2002; Carvalho et al., 2000; Curhan et al., 2004, Uzdenov, 1999; Giantrancesco and Espasito, 2005; Kalin et al., 2004). The study proceded from the need to develop new therapy methods that improve metabolic disturbances and stabilisation of cellular membranes in calculous pyelonephritis.
**Material and methods**

194 patients with calculous pyelonephritis (CP) were observed for following indices: 1) erythrocytes electric membrane disruption (Putvinskiy et al., 1983); 2) kinetics of pH change of erythrocytes suspension by ESL-41-04 electrode on KSL-4 recorder and simultaneously registered by light pass of suspension; 3) microviscosity in erythrocytes membranes by electronic paramagnetic resonance (EPR) method using spinal probe on the base of stearic acid with paramagnetic fragment in ratio 5-12-16 of relative carboxil (5-12-16 doxilsterat) calculated order parameter, defining viscosity in microsurrounding probe (Ingram, 1969). EPR spectrum registered on radio spectrometer “Varian” - 4 (USA) with thermostatic system using spinal probes 5-12-16, doxilsterat of “Suva” firm (USA), easy penetrated in phospholipid regions of membranes.

Electric disruption of erythrocyte membranes and their microviscosity were defined in patients with acute suppurative form of CP in numerous bilateral kidney stones - in 30 patients, with acute serous form of CP - in 31 cases, with unilateral single kidney stones at stage of chronic CP exacerbation - in 34, with latent form of CP with single and numerous kidney stones - in 70 patients. Each observed group was divided into 2 subgroups: a) patients received common therapy (control); b) patients received metabolic therapy (main group); 24 practically healthy children aged from 5 to 14 years were examined as well. Studies were performed on admittance of a patient to clinic, in 3 weeks and in 3 months after basic or metabolic therapy.

Medical treatment included elimination of urolithiasis, antibacterial therapy combined with uroantiseptics; infusion, detoxication and vitamin therapy were performed also.

Medications were used to strength energetic exchange and normalize electric assurance and microviscosity in cellular membrane: lipid acid 0.5% 1-2 ml i/v with 5% glucose; calcium pantothenate 20% 1-2 ml i/v with 50 ml glucose; cocarboxylase 75-100 mg; riboflavin mononucleotide 1% 1-2 ml; nicotinic acid 1% 1-2 ml; alpha tocopherol acetate 5-10 mg/kg; retinol acetate 33 thousands MU i/m; piridoxalphosphate 0.005% 2ml i/m; trental 200-400 mg per day; albumin 10% 10-15 ml/kg twice per week; curantyl 0.5% 2ml; heparin 150 un/kg.

**Results and discussion**

As follows from Table 1 data, electric disruption of erythrocyte membranes in practically healthy children occurred with index 135.4 mW. In patients with acute suppurative form of CP this index made 62.4 mW, in group of patients with acute serous form of CP - 73 mW, in children with latent form of CP - 78 mW. Patients with acute suppurative form of CP in bilateral numerous stones had considerable decrease of electric membrane stability by 43-46% as compared with control group. The index lowered by 27% in acute serous form with unilateral single stones and latent form.

The magnitude of electric disruption, in main group with acute suppurative form of CP to the end of 3rd week metabolic therapy, increased in 15.1% (P<0.002) in comparison with indices before therapy. The magnitude of diffusion potential increased by 84% as compared with the control group. Authentic increase of potential electric permeance was noted in groups of patients with acute serous form of chronic CP at the stage of exacerbation and latent course in the comparison with control.

To the end of therapy (3 months) the magnitude of erythrocytes membrane disruption did not reach control level in patients with acute suppurative form of CP in bilateral stones. Performed complex therapy led to authentic differences between main group and control group (P<0.002) in all clinical groups. This showed the efficiency of metabolic therapy component both in single and in numerous kidney stones as compared with common therapy.
Thus, the measurement of electric disruption in erythrocyte membranes allowed establishing significant disorders of structural functional organizations in patients’ erythrocytes. Initial period of disease was characterized by sudden decrease of membrane stability. This testified instability of membranes to increased penetration of ions that can be serious premises for haemolysis of erythrocytes in CP and disorder of kidney membrane penetration.

Study results of microviscosity of erythrocytes membranes shown in Table 2 revealed different value order parameter in all clinical forms as compared with data of healthy children (P<0,001). We used probes allowed registering mobility along the length of carbohydrate structure of fatty acid acyl. Decrease of microviscosity of outer layer of membranes in three clinical forms using probe 5-DS was detected in the comparison with control group in 18-14-15% accordingly to severity degree.
Analysis showed that membrane microviscosity in patients with acute form of CP (probe 5-DS) increased by 8% in control group, and by 18% in main group. In exacerbation of chronic CP with numerous kidney stones membrane microviscosity increased by 3-9%, and in latent form - by 8-11%. Studies with probes 12DS and 16-DS revealed decrease of membrane microviscosity in acute form of CP in control group - by 4-8%, and in main group - by 12-17%.

In contrast to probe 5-DS, studies with probes 12-DS and 16-DS in zone of terminal region of fatty acid chain showed increase the level of erythrocyte membrane microviscosity; microviscosity growth depended on diffusion and activity of inflammatory process. Analysis showed that after therapy of patients with acute forms with vitamin coenzymes, antioxidants, antiaggregants the value of order parameters for stearic probe 5-DS (P<0.02) significantly increased by 18% in comparison with common therapy methods. The value of order parameters for probe 12-DS (P<0.01 and P<0.02) and 16-DS (P<0.01 and P<0.02) was reduced, respectively. Examination of similar indices in chronic form of CP found slight positive change.

Thus, we developed complex of therapy that allowed significant equalizing of erythrocyte membrane microviscosity in therapy process. However, despite of efficiency of this therapeutic method in children with acute and chronic forms of CP, the complete normalization of membrane microviscosity did not occur as it required more prolonged therapy. At the same time, increase of microviscosity in the area of probe 5-DS seemed to be related with reduction of hydrolysis of polar heads of membranes by phospholipase D; due to this their amount became higher in hygrophilous part of membranes. On the other hand, it is known that diminution of microviscosity in the area of probes 12-DS and 16-DS is related with reforming of fatty acid acyls of phospholipids under the effect of vitamin coenzymes and antioxidants.

References


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