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Structure-Forming Properties of Blood Plasma of Patients with Interstitial Lung Diseases

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Abstract: The main purpose of our research is to study structure-forming properties of blood plasma of patients with chronic interstitial pulmonary disease. 2 groups of patients were formed. 15 patients with interstitial lung fibrosis (ILF) were included in the 1-st group. 27 patients with idiopathic interstitial pneumonia (IIP) were included in the 2-nd group. The control group consisted of 15 healthy ones of same age group. There were three morphotypes of blood plasma fascias at ILP patients. Four morphotypes of blood plasma fascias have been found at IIP patients. The different morphotypes of blood plasma fascias could be connected with formation and accumulation of different types of modified proteins and extracellular nucleic acids in blood plasma of patients with the interstitial lung diseases.

Key words: Interstitial Lung Diseases · Structure-Forming Properties · Blood Plasma

INTRODUCTION

The analysis of structure-forming properties of biological liquids by method of cuneal dehydration is one of the perspective directions of medical-biological researches. The biological liquids are complex colloid systems. A process of drying of drop of biological liquids demonstrates the transitions between different physical-chemical conditions. A sequence of events from formation of gel matrix till crystallization is observed in the result of increase of concentration of soluble substances, aroused by evaporation of solvent [1-6]. Change of physical-chemical parameters of biological liquids impacts on the picture of forming structures in the process of drying of drop. Pathological process changes physical-chemical properties of bioliquid and this determines the type of the observed patterns.

The studies of structure-forming properties of blood are conducted at the various pathological conditions, including the respiratory diseases. For example, the morphotypes of structure-forming properties were used for detecting of phase of tuberculous process and clinical form of the disease. The fibrocavernous, infiltrative and disseminated forms of pulmonary tuberculosis were associated with the plaque structures and folded structures in blood plasma fascias. The tonque microstructures recorded in the fascias of the patients with tuberculous pleurisy. The pathologically changed leaves like structures are present in the fascias at the fibrosis of lung tissue [7].

Obuchova L.M. and etc. showed the changes of morphotypes of teziogrammas at the patients with chronic bronchitis [8]. The distinctions of structure-forming properties of blood and neutrophil lysate at the patients with chronic obstructive lung disease were showed by our own researches [9]. At the same time, there are no studies of structure-forming properties of blood of the patients with chronic interstitial lung disease.

The main purpose of our research was to study structure-forming properties of blood plasma of patients with chronic interstitial pulmonary disease.

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MATERIALS AND METHODS

2 groups of patients were formed. 15 patients with interstitial lung fibrosis (ILF) were in the 1-st group. 27 patients with idiopathic interstitial pneumonia of middle degree (IIP) and respiratory failure of second degree were in the 2-nd group. The control group consisted of 15 healthy ones of same age group.

Clinical profile of the patients. Rapidly progressing clinical course was observed mainly in a group of patients with ILF. Dyspnea became more continuous, tended to advance and was observed during rest, poor exercise capacity was noted. Rarely in our observations of young patients that we observed dyspnea arose abruptly and rapidly intensified. Respiratory rate was up to 30-35 respiratory movements per minute during periods of activity. Disease was characterized by tussis (100%), chest pains, osteoarthropathy in the form of changing of end-point maniphalanxes and nails by type of clubbed fingers and turtle-back nails (Hippocratic fingers) (67%). Weight loss was present in 77% of patients with ILF, somewhat less often patients of this group complained on loss of appetite (55%). Timeline of the disease, according to our records, rarely exceeded 4-5 years.

Persisting chronicity with sequence of exacerbations and remissions and domination of younger patients – compared to ILF - (41,9±14,4 years) was noted in group of patients with IIP. In the process of examination there were no smokers in IIP group. 31 patients (20,3%) smoked previously, 3 to 25 cigarettes a day. Smoking history ranges from 6 months to 15 years. Patients left off smoking 10-12 months prior to the beginning of examination. In IIP compared to ILF dyspnea was of persisting character, less apparent, progressed slower, gradually limiting physical activity. As a result, discomfort and dyspnea kept at lower physical activity level in comparison with healthy men of the same age even in the periods of remission. All patients had tussis in IIP as well as in ILF. Significantly less often thoracalgia and chest discomfort were observed (20%). During auscultation delicate crepitus could be heard in all patients, its sound comparable to cellophane crackling and it was localized mainly in basal areas of lungs. Bloody expectoration episodes were noted somewhat more often in the group of ILF – in 3 patients (9%), IIP – in 5 patients (6%).

Ethics. The medical ethics committee of the Medical University (Karaganda) approved the study. All patients and healthy subjects have received the full information on probable inconveniences and complications at the blood sampling before giving their consent to participate.

Blood collected from the cubital vein (3 ml/sample) was drawn into vacutainer tubes containing heparin. Erythrocytes were separated from plasma by centrifugation. Investigations of blood plasma were done within 1 hour after its collection.

The structure forming properties of blood were studied using the method of cuneal dehydration or teziography [10]. Principle of teziography method: the drop of biological fluid is fixed on a solid substrate. After the evaporation of free water a drop of blood plasma is transformed in to the solid phase and forms the facias.

Fascia – is structural macro portrait, reflecting the biochemical status of the biological liquid, which are defined by concentrations of metabolits and by their molecular interactions [10,11].

The obtained fascias were scanned by scanner Canon CanoScan D646Uex with use of program ABBYY FineReader 7.0 Professional Edition in the regime of 1200 dpi and depth of color 32-bit.

The next list of criterions was used in type of parameters of description of facias: character of system structures (presence and clarity of zones: marginal, intermediate and central); character of lines of cracking (form, symmetry, clarity, density); character of subsystemic structures: presence and character of amorphous regions: (small, medium, big); presence, distribution, sizes and quantity of concretions.

The appearance, location and types of pathological structures (types of structures: «leaves», «wrinkles», «harnesses», «dashed cracks», etc.) were also recorded [12].

RESULTS

Typical facia of blood plasma of healthy ones was characterized by zonation (marginal, intermediate and central), symmetrical distribution of systemic and subsystemic structures; clearly delineated boundary of facia; predominant of radial type of cracking; reticulate cracking, that characterizes a very high density of cracking and order of ramification in the structure of facia; very high amount of concretions, which are present practically in every cleavage of all three zones of facia; small concretions of roundish form.

The atypical concretions, amorphous regions and pathological structures in the structure of blood plasma of healthy ones were not formed (Figure 1).

In the result of study of structure formation of blood plasma facias of ILP patients three morphotypes of facias have been found, which were presented in the equal percentage.

1-st morphotype of facia of blood plasma of ILF patients was characterized by retention of 3 zones, symmetry, clearly delineated boundary, radial type of cracking, density of cracking and order of ramification, which observed in the facias of blood plasma of healthy humans. There were no pathological structures in facias (Figure 2).

2-nd morphotype of facia of blood plasma of ILF patients was characterized by presence of strong systemic infringements such as loss of intermediate zone, partial loss of symmetry, weakly defined protein bead of marginal zone, chaotic cracking in the central zone, lowering of density of cracking and order of cracking, decrease of amount of concretions (Figure 3). The infringements of subsystemic level were absent.

3-rd morphotype of facia of blood plasma of ILF patients was characterized by presence of systemic infringements: loss of intermediate zone, symmetry, formation of amorphous region in the central zone; the decrease of amount of concretions and formation of concretions with atypical sizes and forms.

Besides systemic infringements 3-rd morphotype of facia had subsystemic infringements presented by pathological structures like the «leaves» and «fused leaves» (Figure 4).

Consequently, such type of facia of blood plasma of ILF patients, showed the not only presence systemic parameters but the appearance of subsystemic infringements, which demonstrate the metabolic changes in the organism of patients of this subgroup.

Four morphotypes of fascias have been found in the result of the study of blood plasma of patients with IIP.

1-st morphotype of facia of blood plasma was observed at the 30% of IIP patients. The facias of 1-st morphotype had distinguishing peculiarities: presence of 3 zones, retention of symmetry, clearly delineated boundary, radial type of cracking, high density of cracking and order of ramification; large amount of typical concretions.

The single pathological structures of type «wrinkles» were formed in the marginal zone at this time (Figure 5).

And so, 1-st morphotype of facia of blood plasma of patients with IIP had similarity with the character of formation of facia with control ones. Formation of single pathological structures of wrinkle type in the marginal zone testified about presence of metabolic infringements, associated, first of all, with modification of proteins.

2-nd morphotype of facia of blood plasma was present at the 20% of IIP patients (Figure 6).

This morphotype of facias was characterized by retention of 3 zones, partial loss of symmetry, clearly delineated boundary, chaotic type of cracking in the central zone, formation of small concretions of atypical forms, full absence of pathological structures. Similar picture of facias demonstrated the presence of systemic infringements in the structure formation of blood plasma of patients with IIP.

3-rd morphotype of facias of blood plasma was present at the 40% of IIP patients and was characterized by formation of 2 subtypes.

1-st subtype of 3-rd morphotype of facias of blood plasma of patients with IIP was observed in the 20% and was characterized by next parameters: loss of intermediate zone; retention of symmetry; clearly delineated boundary; radial type of cracking; decrease of density of cracking and order of ramification; reduction of amount of formed concretions; formation of atypical concretions according to sizes and forms; formation of large amount of pathological structures like the «leaves» in the marginal zone, that was considered to be a marker of sclerotic changes in the blood system (Figure 7).

A combination of these changes permitted to make a conclusion about development of infringements as systemic, so and subsystemic levels.

2-nd subtype of 3-rd morphotype of facias of blood plasma was observed at the 20% of IIP patients and was characterized by next parameters: loss of intermediate zone and symmetry, clear -cut marginal contoured, chaotic type of cracking, decrease of density of cracking and order of ramification, reduction of amount of formed concretions, formation of concretions, having atypical sizes and forms and also, formation of many pathological structures like the «leaves».

Consequently, this subtype of facias showed the hard metabolic changes in the organism of IIP patients (Figure 8).

4-th morphotype of facias of blood plasma of IIP patients was present in the 10% of cases and was characterized by peculiar structure of facia (Figure 9).

This morphotype was characterized by clear –cut protein bead of marginal zone. The cleavages of marginal zone formed with the concretions of atypical sizes and forms. A central zone was presented by amorphous region, which contained lipid inclusions, forming a of half moon structure. The visual subsystemic structures were absent.

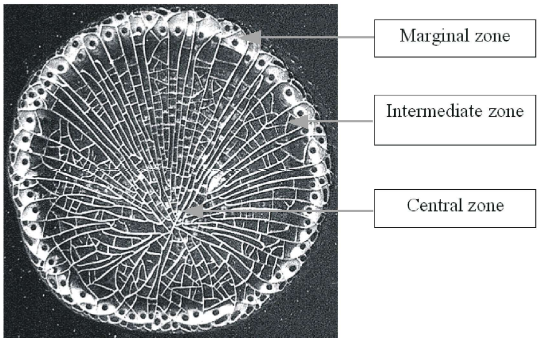

Fig. 1: Typical facia of blood plasma of healthy subject

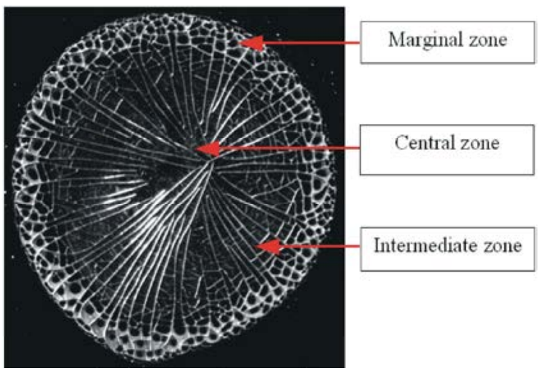

Fig. 2: 1-st morphotype of blood plasma facia at ILF patients

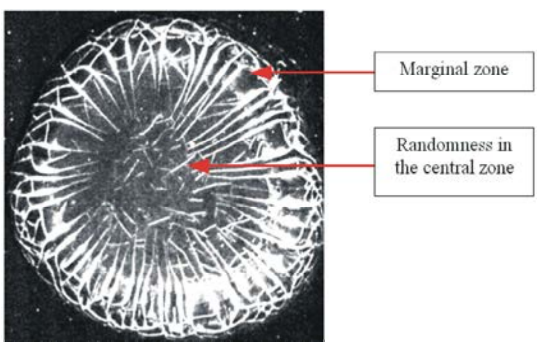

Fig. 3: 2-nd morphotype of blood plasma facia at ILF patients

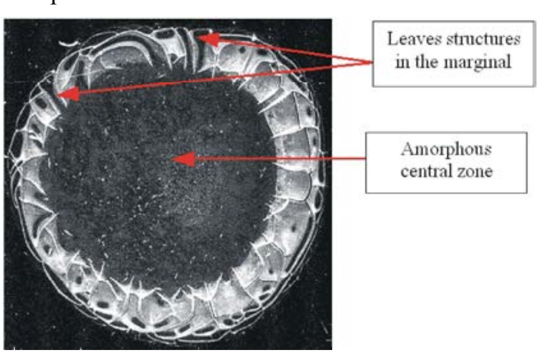

Fig. 4: 3-rd morphotype of blood plasma facia at ILF patients

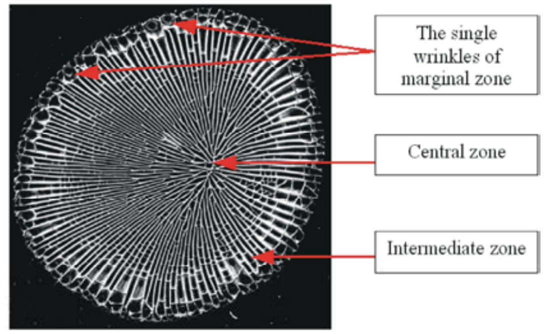

Fig. 5: 1-st morphotype of blood plasma facia of IIP patients

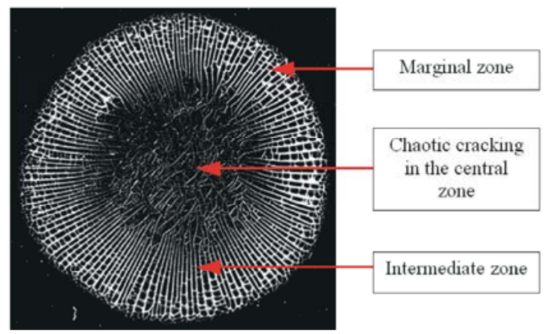

Fig. 6: 2-nd morphotype of blood plasma facia of IIP patients

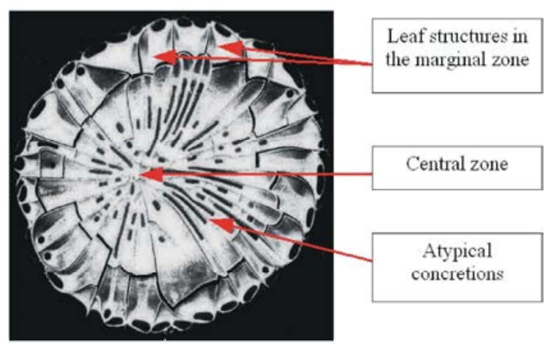

Fig. 7: 1-st subtype of 3-rd morphotype of blood plasma facias at IIP patients

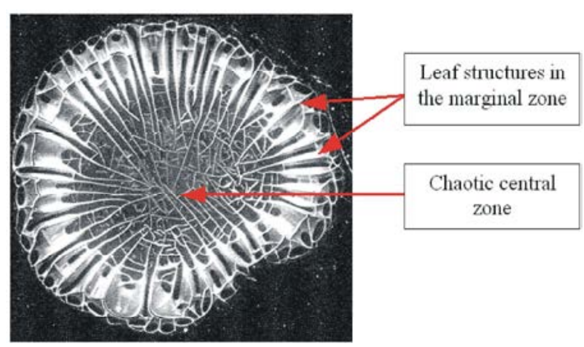

Fig. 8: 2-nd subtype of 3-rd morphotype of blood plasma facias at IIP patients

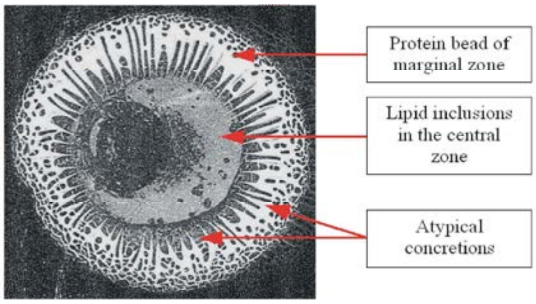

Fig. 9: 4-th morphotype of blood plasma facia at IIP patients

DISCUSSION

Our research has shown the alteration of fascia morphotypes of blood plasma of patients with the interstitial lung diseases. We assumed that the main reason to be connected with formation and accumulation of different types of modified proteins in blood plasma of patients with the interstitial lung diseases [13, 14]. An albumin in blood plasma could be considered as one of the main target for modification. The ratio of oxidized and reduced forms of albumin, formation of Ischemia modified albumin have been discussing as special mechanism of some disease development and progression. Reduced forms of albumin could be evacuated from lung tissue [15]. Disorder of oxygenation contributed to Ischemia modified albumin formation [16].

Another reason we proposed may be connected with accumulation of extracellular nucleic acids [17]. In any case we will continue our research to explain the presence of different morphotypes of fascias within each group of patients with ILF and IIP.

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