EXPERIMENTAL METHODS FOR CLINICAL PRACTICE

Surface Architectonics of Peripheral Blood Erythrocytes in Patients with Mental Diseases

V. V. Novitskii, N. V. Ryazantseva, and I. R. Semin

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Scanning electron microscopy demonstrated altered surface topography of peripheral erythrocytes in patients with nonpsychotic mental diseases, nonmetabolic mental retardation, and paranoid schizophrenia. Maximum decrease in the number of biconcave diskocytes and accumulation of transitional, prehemolytic, and degenerative forms of erythrocytes were found in schizophrenia.

Key words: *erythrocyte; mental diseases; scanning electron microscopy*

Recent studies of etiology and pathogenesis of mental disorders are focused on the metabolism and structural and functional peculiarities of cell membranes [6,7, 9,10]. In light of this, the search for integral parameters reflecting the intensity of destructive processes in cell membranes becomes very actual. For instance, transformation of circulating erythrocytes can reflect the state of cell hemolysis [12]. Erythrocyte membranes are similar by general organization and functioning to other plasma membranes [4]. Erythrocyte surface architectonics (ESA) during physiological reactions and pathological processes is important for evaluation of general biological properties of cell membranes in the body. In the present study we analyzed surface architectonics of peripheral blood erythrocytes in patients with different mental disorders.

MATERIALS AND METHODS

The study was carried out on 86 patients (60 men and 26 women aged 17-52) with different mental disorders receiving no psychopharmacotherapy. Group I included patients with paranoid schizophrenia (codes F20.00-03 according to International Nosology-10, n=38) in active phase (manifested or acute state, n=18) or during stable remission (n=20). Group II comprised 24 patients with mild and moderate mental retardation of nonmetabolic etiology (codes F70.1, F71.1). Group III included 24 patients with nonpsychotic mental disorders: personality disorders (n=7, codes F60.3, F60.6), adaptation disorders (n=12, codes F43.0, F43.20-22, and F43.25), and neurasthenia (n=5, Code F48.0). Control group consisted of 48 healthy donors of appropriate sex and age. No subjects with inherited somatic diseases, alcoholism, and drug abuse were included.

ESA was examined by scanning microscopy. Peripheral blood samples were double fixed and dehydrated as described elsewhere [3] and examined under a REM-200 electron microscope (35 kV accelerating voltage, 0.63 A current, and 35°). In each preparation 1000 erythrocytes were counted and morphological forms [2,3] were quantified. In 50 randomly selected erythrocytes the external diameter and the diameter of central cavity were measured and their ratio was calculated. Preparations were photographed under a JEM-100 electron microscope.

The results were processed statistically using Student's t test.

Siberian Medical University, Tomsk; Institute of Pharmacology, Tomsk Research Center, Siberian Division of the Russian Academy of Medical Sciences. ***Address for correspondence:*** ryazan@mail.tomsknet.ru. Novitskii V. V.

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RESULTS

Normal erythrocytes were presented mainly by functionally active biconcave diskocytes (BD). Transformed erythrocytes were presented by reversibly changed transitional forms (ellipsoid and flat disk-shaped erythrocytes, diskocytes with one or multiple processes and a crest, and mulberry-shaped erythrocytes) and irreversibly changed prehemolytic (spherical, drained and dome-shaped) and degenerative erythrocytes (Table 1; Fig. 1, *a*). Distribution of morphological forms of erythrocytes was similar in men and women.

All patients with mental disorders showed high heterogeneity of erythrocyte population: the number of BD significantly decreased while the percentage of transitional, prehemolytic, and degenerative forms increased (Table 1, Fig. 1, *b*, *c*).

Surprisingly, surface ultrastructure of erythrocytes in patients with personality and neurotic disorders, which were traditionally regarded as "functional" diseases, was also altered. In these patients, decreased content of BD with smooth homogenous membrane ($p<0.001$) was associated with accumulation of transitional, prehemolytic, and degenerative erythrocytes: their number increased 1.3-, 1.5- and 3.5-fold, respectively, compared to healthy donors. Patients with mental retardation showed significant ($p<0.001$) increase in transitional forms due to increased number of cells with crest, one or multiple processes compared to these parameters in patients with nonpsychotic mental disorders. The content of other morphological forms was the same as in patients with borderline disorders (Table 1).

More pronounced disorganization of ESA was found in patients with paranoid schizophrenia. The type and the degree of erythrocyte transformation were similar during acute and remittent stages, therefore, all schizophrenic patients were united into one group. In patients with paranoid schizophrenia, the number of BD was significantly lower than in patients with nonpsychotic mental diseases ($p<0.001$) or metal retardation ($p<0.05$), while the number of prehemolytic and degenerative erythrocytes significantly surpassed their contents in patients with other mental disorders (Table 1).These morphological changes probably result from structural and dynamic abnormalities of lipid bilayer and disturbed ion transport in erythrocyte membranes in schizophrenia [8,11,13]. It is important to note that more detailed analysis of distribution of morphological forms depending on the duration and character (continuous or paroxysmal) of schizophrenic process revealed no differences ($p>0.05$). The absence of a correlation between disorganization of erythrocyte membrane and activity of the pathological process can be regarded as a manifestation of genetically determined constitutional feature of schizophrenic patients.

Thus, we revealed changes in ESA and increased polymorphism of erythrocytes in patients with nonpsychotic mental disorders, mental retardation, and paranoid schizophrenia. Maximum disorganization of the morphological status was found in patients with schizophrenia, while minimum changes were typical

TABLE 1. Morphological Characteristics of Erythrocyte Population (in %) in Patients with Mental Disorders. Scanning Electron Microscopy ($X\pm m$)

Morphological forms	Healthy donors	Nonpsychotic mental disorders	Mental retardation	Paranoid schizophrenia
Normal BD	87.77±0.12	83.04±0.37*	81.28±0.28**	80.59±0.19***×
Reversibly transformed erythrocytes:				
ellipse	0.24±0.02	0.49±0.04*	0.39±0.05**	0.58±0.04*×
flat disks	0.21±0.01	0.75±0.07*	0.73±0.08*	0.95±0.03***×
diskocytes with a process	3.62±0.08	4.96±0.04*	5.48±0.11**	5.19±0.09****××
discocytes with a crest	4.56±0.06	5.28±0.11*	6.07±0.12**	5.88±0.07**
discocytes with multiple processes	0.67±0.03	0.88±0.06**	1.19±0.04**	1.24±0.02**
mulberry-shaped erythrocytes	0.12±0.01	0.11±0.01	0.11±0.01	0.13±0.01
Irreversibly transformed erythrocytes:				
dome-shaped	1.04±0.17	1.33±0.06	1.26±0.07	1.51±0.03****×
spherical	1.26±0.02	1.96±0.10*	2.13±0.09*	2.33±0.02**××
drained	0.52±0.03	0.69±0.03*	0.78±0.04*	0.84±0.02**
degenerative	0.19±0.01	0.66±0.05*	0.57±0.07*	0.79±0.03****×

Note. *$p<0.001$, **$p<0.01$ compared to healthy donors; *$p<0.001$, **$p<0.01$, ***$p<0.05$ compared to patients with nonpsychotic mental disorders; ×$p<0.01$, ××$p<0.05$ compared to patients with mental retardation.

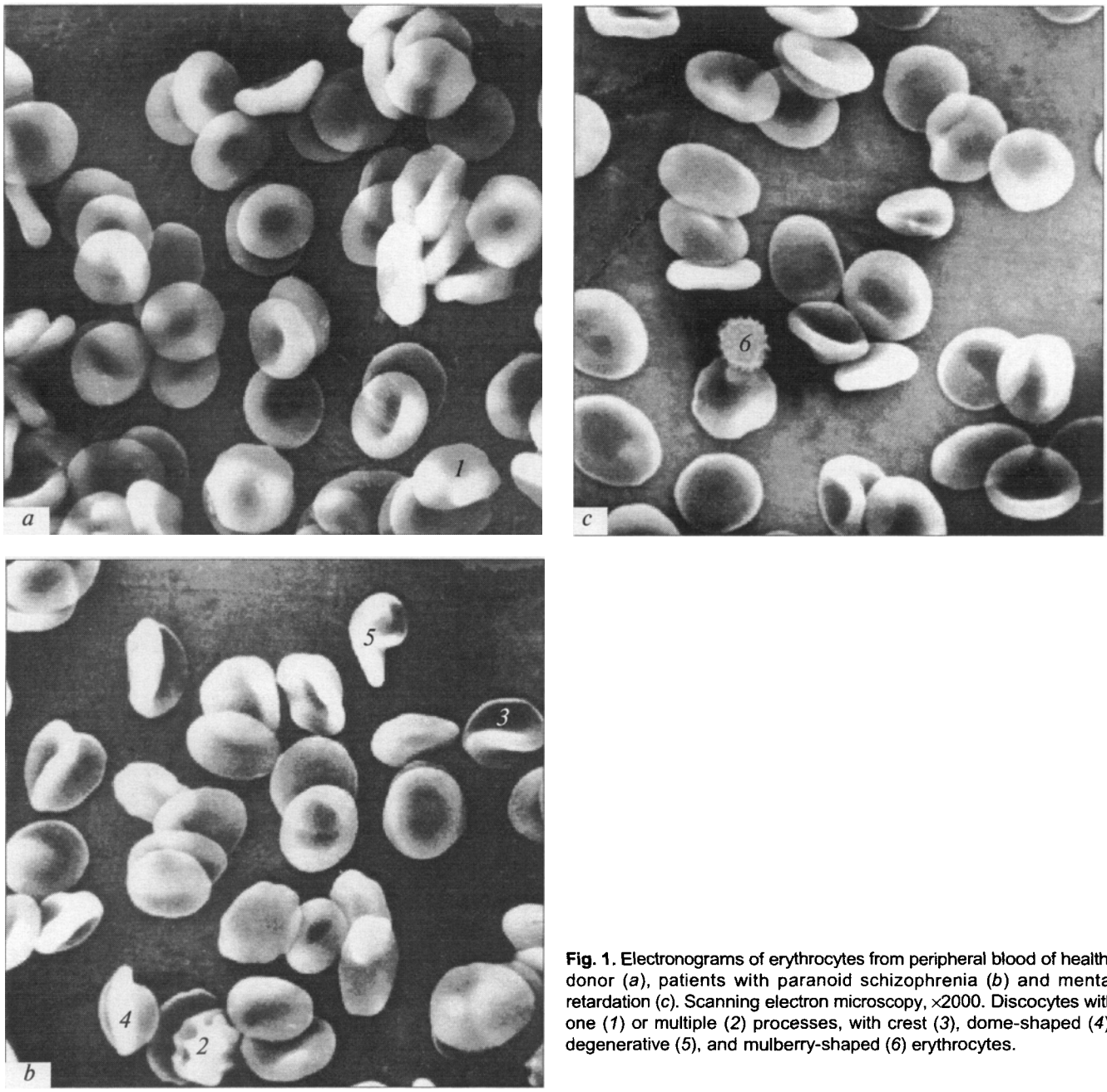

Fig. 1. Electronograms of erythrocytes from peripheral blood of healthy donor (*a*), patients with paranoid schizophrenia (*b*) and mental retardation (*c*). Scanning electron microscopy, ×2000. Discocytes with one (*1*) or multiple (*2*) processes, with crest (*3*), dome-shaped (*4*), degenerative (*5*), and mulberry-shaped (*6*) erythrocytes.

of personality and neurotic disorders. Since many pathological processes are associated with impairment of cell membranes [1] and the observed erythrocyte transformation can result from structural and metabolic changes in their membranes [5], it was logical to arrange mental disorders in the following order according to the degree of molecular membrane impairment: nonpsychotic mental disorders, mental retardation, and schizophrenia.

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