



Space weather and cardiovascular system. New findings

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Researches of last two decades have shown that the cardiovascular system represents the most probable target for influence of helio - and geomagnetic activity. Both cardiovascular system and system of blood are connected very closely: one system cannot exist without another. For the same reason the effects perceived by one system, are easily transferred to another. Laboratory tests such as blood coagulation, platelet aggregation, and capillary blood velocity (CBV) performed in Scientific Clinical Center JSC "Russian Railways in patients suffering from coronary heart disease (CHD) revealed a high dependence with a level of geomagnetic activity.

Results of these and other findings allow to assume that blood itself can be a sensor of geomagnetic fields variations because erythrocytes, platelets, and leucocytes bearing electric charge on membranes, and in a comparable magnetic field can change as own properties and properties of blood flow. It is interesting that not only geomagnetic disturbances, but also the periods of very quiet geomagnetic conditions affect a capillary blood velocity, slowing down it. It was shown during long-term experiment with isolation named "MARS-500" in spatial facility of the Institute of Biomedical Problems in Moscow as imitation of an extended space mission to Mars. Using digital capillaroscope "Russia", two crewmembers - medical doctors made records of microcirculation parameters at themselves and other four participants of "Martian" team. Capillary records were performed before, during, and after period of isolation in medical module of MARS-500 facility. At the period of experiment nobody of crewmembers knew about real geomagnetic conditions. In days of active geomagnetic conditions average CBV has registered as $389 \pm 167 \mu\text{m/s}$, that statistically significant ($p < 0.05$) in comparison of CBV for simply quiet geomagnetic conditions days. We separated quiet geomagnetic conditions on two parts: very quiet geomagnetic conditions (Amsk 1-4) and simply quiet geomagnetic conditions (Amsk 5-7) as our study has revealed a significant difference in values of CBV. Whereas in simply quiet geomagnetic conditions CBV has made $643 \pm 178 \mu\text{m/s}$, at very quiet geomagnetic conditions CBV gave delay of average CBV: $435 \pm 223 \mu\text{m/s}$ ($p < 0.02$). This phenomenon probably depends on a galactic cosmic rays intensity that rise when solar wind intensity decrease.

During 14 years we collected more than 25000 cases of acute myocardial infarction and brain stroke at seven medical hospitals located in Russia and some other countries. We used only cases with established date of acute attack of diseases. Undated cases were excluded from the analysis. Average numbers of patients at geomagnetic active days and days with quiet geomagnetic condition were compared. It was shown statistically that during geomagnetic disturbances the frequency of myocardial infarction and brain stroke cases increased on the average by a factor of two in comparison with quiet geomagnetic conditions. These results are very close to results obtained by E.Stoupele (1999) for patients suffering with similar cardiological pathology.

Our recent study (with L.Parfeonova) revealed positive correlation between heart ventricular ectopic activity (VEA) and geomagnetic conditions in patients with CHD. During the periods of geomagnetic storms it was revealed the most quantity of VEA in patients with CHD. Minimal quantity of VEA episodes was found for unsettled conditions ($p < 0,05$).