The Efficacy of Mesenchymal Stem Cells Transplantation for Improvement of Microcirculation in the Cerebral Cortex of Nephrectomized Rats

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The purpose of the work was to study the effect of intravenous transplantation of human mesenchymal stem cells (hMSC) on the main parameters of microcirculation (microvascular network density, arterial vessel reactivity, tissue perfusion (P) and oxygen saturation (SatO2)) in rat cerebral cortex after nephrectomy. Using the device for studying microcirculation (40× magnification), the density of the entire microvascular network and the density of arterial vessels in the pia mater of the sensorimotor cortex of nephrectomized rats were studied after intravenous transplantation of hMSC. The same device with a larger magnification (160×) was used to study the reactivity of the pial arteries to the acetylcholine (ACh). At the same time, the P and SatO2 indices were measured in the sensorimotor cortex using the LAKK-M laser Doppler. The results demonstrated that 4 months after nephrectomy, the density of the entire microvascular network and the density of arterial vessels decreased on average by 1.3 and 1.5 times, respectively. The reactivity of the pial arteries to ACh deteriorated significantly: the number of enlarged arteries decreased by 2.1–4.4 times. At the same time, a statistically significant decrease of P (by 20%) and SatO2 (from 94.8 ± 0.7% to 91.2 ± 1.8%) was detected. Intravenous administration of hMSC led to the maintenance of the density of the microvascular network of the pia mater in rats after nephrectomy at the same level as in control animals. All other parameters of microcirculation (reactivity, P, SatO2) in the group of cell therapy were also close to the control values. In conclusion, MSCs administration allowed to prevent the degradation of the microvascular bed in the cerebral cortex of rats after nephrectomy and to maintain the main parameters of microcirculation at the same level as in control animals.

Keywords: nephrectomy, brain, intravenous transplantation, mesenchymal stem cells, microvascular bed density, reactivity, perfusion, oxygen saturation