Vascular endothelial cells

The capillary bed of the brain is comprised of a dense network of intercommunicating vessels that consist of specialized endothelial cells and no smooth muscle.

In brain, microvascular endothelial cells are exposed to various forces, including shear stress (SS). However, little is known about the effects of high shear stress (HSS) on human brain microvascular endothelial cells (HBMECs) and the underlying mechanism. The cholesterol efflux regulator ATP-binding cassette subfamily A member 1 (ABCA1) has been demonstrated to exert protective effect on HBMECs. However, whether ABCA1 is involved in the mechanism underneath the effect of HSS on HBMECs remains obscure. In a study, a series of experiments were performed to better understand the effect of HSS on cellular processes of HBMECs and the possible involvement of ABCA1 and PI3K/Akt/eNOS in the underlying mechanisms.

HBMECs were subjected to physiological SS (PSS) or high SS (HSS). Cell migration was evaluated using Transwell assay. Apoptotic HBMECs were detected by flow cytometry or caspase3/7 activity. IL-1β, IL-6, MCP-1 and TNF-α levels were measured by ELISA. RT-qPCR and western blotting were used for mRNA and protein expression detection, respectively. ROS and NO levels were detected using specific detection kits. Compared to PSS, HBMECs exhibited decreased cell viability and migration and increased cell apoptosis, increased levels of inflammatory cytokines, and improved ROS and NO productions after HSS treatment. Moreover, HSS downregulated ABCA1 but upregulated the cholesterol efflux-related proteins MMP9, AQP4, and CYP46 and activated PI3K/Akt/eNOS pathway. Overexpression of ABCA1 in HBMECS inhibited PI3K/Akt/eNOS pathway and counteracted the deleterious effects of HSS. Contrary effects were observed by ABCA1 silencing. Inhibiting PI3K/Akt/eNOS pathway mimicked ABCA1 effects, suggesting that ABCA1 protects HBMECs from HSS via PI3K/Akt/eNOS signaling.

These results advanced our understanding on the mechanisms of HSS on HBMECs and potentiated ABCA1/PI3K/Akt/eNOS pathway as therapeutic target for cerebrovascular diseases [1].

Endothelial cell coverage along the Pipeline embolization device (PED) is one of two primary proposed mechanisms of action of the device, along with induction of intra-aneurysmal thrombosis [2].

In high grade gliomas, endothelial cell proliferation is 40-fold greater than that of normal brain tissue [3].

Angiopoietin 2 protein was detected not only in endothelial cells but also in glioma cells, and its expression was prominent in both the area surrounding the necrosis and the periphery of glioblastomas.

White matter infarct induces demyelination and brain dysfunction.

Xu et al. previously reported that transplantation of brain microvascular endothelial cells (MVECs) improved the behavioral outcome and promoted remyelination via increasing the number of

oligodendrocyte precursor cells in the rat model of white matter infarct.

In a study, Xu et al. investigated the effects of transplantation of vascular endothelial cells generated from human induced pluripotent stem cells (iPSCs) on the rat model of white matter infarct. Seven days after induction of ischemic demyelinating lesion by injection of endothelin-1 into the internal capsule (IC) of a rat brain, iPSC-derived vascular endothelial cells (iVECs) were transplanted into the site of demyelination. The majority of iVECs transplanted into the IC survived for 14 days after transplantation when traced by immunohistochemistry for a human cytoplasmic protein. iVEC transplantation significantly recovered hind limb rotation angle as compared to human iPSC or rat meningeal cell transplantation when evaluated by footprint test. Fourteen days after iVEC transplantation, the infarct area remarkably decreased as compared to that just before the transplantation when evaluated by magnetic resonance imaging or luxol fast blue (LFB) staining, and remyelination was promoted dramatically in the infarct when assessed by LFB staining. Transplantation of iVECs increased the number of oligodendrocyte lineage cells and suppressed the inflammatory response and reactive astrocytogenesis. These results suggest that iVEC transplantation may prove useful in treatment for white matter infarct [4].

1)
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