What is the difference between blood-nerve barrier and blood-brain barrier?

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Abstract

The blood-brain barrier (BBB) and blood-nerve barrier (BNB) play crucial roles in maintaining homeostasis of central and peripheral nervous systems. Takeshita et al. reported the different molecular expression pattern in the components constituting BBB and BNB, and suggested that BNB might have distinct mechanism for T cell migration.

Text

The blood–brain barrier (BBB) and blood-nerve barrier (BNB) constitute complex interface between blood and the central nervous system (CNS) and peripheral nervous system (PNS). BBB strictly controls the exchanges of molecules between the blood and brain. Its integrity is essential to protect brain parenchyma from blood-derived toxic components and to regulate transmigration of immune cells, while permitting transport of mandatory molecules to maintain brain function in physiological condition [1]. The barrier disruption may lead to various inflammatory or immune-mediated diseases of the CNS such as multiple sclerosis and Alzheimer's disease or be accompanied by the pathological conditions. BNB dysfunction may also cause or accompanied by inflammatory neuropathies or peripheral nerve injury.

BBB is mainly composed of brain microvascular endothelial cells, pericytes, astrocytes and basement membranes. Endothelial cells seal the barrier via tight junction protein including claudins, occludins and tricellulin. Integrity of the BBB is also maintained by attachment of endothelial cells to basement membrane composed of extracellular matrix molecules such as laminin isoforms, collagen IV, and fibronectin [2]. Laminin is a trimeric molecule comprised of α, β and γ-subunits, five α, four β, and three γ chains have been identified and these are able to combine and form 16 different laminin isoforms. The endothelial basement membrane can be identified by the presence of laminin-α4, β1, and γ1 (411) and laminin-α5, β1, and γ1 (511) [3,4].

BNB has a similar structure as the BBB with the exception of lacking astrocytes and the glia limitans formed by astrocytes. In spite of the lack of astrocytes and glia limitans in BNB, recent several reports showed that the BNB has almost the same properties as a barrier system with those with BBB, which suggests that the specific structural component of basement membrane at the BNB affects the barrier function [5]. Among extracellular matrix molecules, laminin is suggested to be relevant for the BBB integrity. T lymphocytes expressed integrin α6β1 that is a major counterpart

receptor of laminin α4, and it facilitates the transmigration of T cells into brain parenchyma through BBB. In laminin α4-deficient mice, severity of experimental autoimmune encephalomyelitis (EAE) is ameliorated accompanied by the reduced transmigration of T cells, and laminin α5 inhibits T cell migration [6]. Thus, laminin isoforms are suggested to play an important role as a barrier of BBB.

Takeshita et al. investigated if laminin isoforms also play important roles in BNB as in BBB, and reported that the expression of laminin α4 is selectively decreased in BNB compared to BBB in laminin isoforms α5, α4, β1, β2 and γ1 they immunohistochemically analyzed [7]. The decreased laminin α4 is consistently observed immunohistochemically in median nerve of postmortem patient with amyotrophic lateral sclerosis (ALS) and sural nerve biopsy samples from patients with four different neuropathies, while other laminin isoforms are consistently expressed in both BBB and BNB. Thus, it can be speculated that T cells migrate across the BNB via other factors except for laminin α4 in autoimmune neuropathies, suggesting that BNB has its own barrier system because of lack of laminin α4 in BNB.

Their report actually suggests a distinct barrier structure and function of BNB from those of BBB. However, it was deduced from only immunohistochemical analysis. The precise structure and function of BNB still remains to be elucidated, whereas BNB is supposed to play critical roles in physiological and pathological conditions in the peripheral nervous system. Further functional analysis of BNB by the lack of laminin α4 is warranted.

Conflict of interest

None declared.

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