The Glymphatic System and Nocturnal Brain Clearance

Jasminka Milas-Ahić[1,2]

[1] Department of Rheumatology, Clinical Immunology and Allergology, Department of Internal Medicine, University Hospital Centre Osijek, Osijek, Croatia
[2] Faculty of Medicine, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia

Contact: jmahic@mefos.hr

Abstract

The glymphatic system is a macroscopic network based on perivascular channels formed by astroglial cells, serving to remove soluble proteins and metabolic by-products from the brain. The movement of cerebrospinal fluid through brain tissue enables the transport and elimination of harmful proteins, particularly during deep sleep (slow-wave sleep), due to increased interstitial space and reduced noradrenergic signaling, which allow greater cerebrospinal fluid influx and more efficient clearance. Nocturnal brain clearance through this mechanism is crucial for eliminating neurotoxic substances such as beta-amyloid and tau proteins, which are associated with neurodegenerative disorders. Impaired glymphatic function leads to the accumulation of neurotoxic substances linked to diseases such as Alzheimer's and Parkinson's disease, highlighting its importance for cognitive health. The glymphatic system plays a fundamental role in memory and overall brain health, particularly in older adults, and research into this system contributes to understanding the neurobiological changes associated with aging.

Keywords: glymphatic system; sleep; neurodegenerative disorders

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Glimfatički sustav i noćno „čišćenje" mozga

Jasminka Milas-Ahić[1,2]

[1] Zavod za reumatologiju, kliničku imunologiju i alergologiju, Klinika za unutarnje bolesti, Klinički bolnički centar Osijek, Osijek, Hrvatska
[2] Medicinski fakultet, Sveučilište Josipa Jurja Strossmayera u Osijeku, Osijek, Hrvatska

Kontakt: jmahic@mefos.hr

Sažetak

Glimfatički sustav makroskopska je mreža temeljena na perivaskularnim kanalima koje oblikuju astroglijalne stanice, a služi za uklanjanje topljivih proteina i metaboličkih nusprodukata iz mozga. Kretanje cerebrospinalne tekućine kroz moždano tkivo omogućuje transport i eliminaciju štetnih proteina, osobito tijekom dubokog spavanja (sporovalnog spavanja), zbog povećanog intersticijskog prostora i smanjene noradrenergičke signalizacije, što omogućuje veći dotok cerebrospinalne tekućine i učinkovitije uklanjanje štetnih tvari. Noćno „čišćenje" mozga putem ovog mehanizma ključno je za eliminaciju neurotoksičnih tvari, poput beta-amiloida i tau proteina, koji su povezani s neurodegenerativnim poremećajima. Poremećaj glimfatičke funkcije dovodi do nakupljanja neurotoksičnih tvari povezanih s bolestima poput Alzheimerove i Parkinsonove bolesti, što naglašava važnost ovog sustava za kognitivno zdravlje. Glimfatički sustav ima temeljnu ulogu u pamćenju i općem zdravlju mozga, osobito u starijih osoba, a istraživanja ovog sustava pridonose razumijevanju neurobioloških promjena povezanih sa starenjem.

Ključne riječi: glimfatički sustav; spavanje; neurodegenerativni poremećaji

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