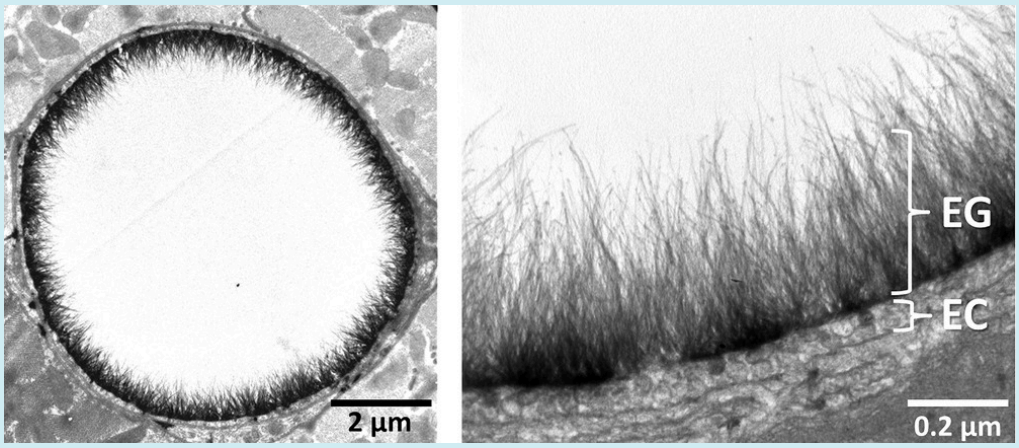
Glymphatics and the Endothelial Glycocalyx



The **Endothelial Glycocalyx** resembles a shag carpet lining the interior of a blood vessel.

Image from: Haeren, Roel & van de Ven, Steffi & Zandvoort, Marcus & Vink, Hans & Overbeeke, Jacobus & Hoogland, Govert & Rijkers, Kim. (2016). Assessment and Imaging of the Cerebrovascular Glycocalyx. Current neurovascular research. 13. 10.2174/1567202613666160504104434.

Glymphatic Basics: A Primer
Presentation Summary

M Mark Melin, MD, FACS, RPVI, FACCWS is the Medical Director of the Gonda Vascular Center Wound Clinic at the Mayo Clinic, Rochester, MN. He pre-recorded his presentation and responded to questions for this article.

Recent improvements in imaging allow us to discern the lymphatic, or glymphatic, system within the brain's protective coverings, called meninges. A lymphatic field includes hundreds of lymphatic capillaries surrounding its nodes.

Lymphatic drainage from the head is different from other parts of the body. As brain tissue becomes stiff due to age or illness, fluid builds up like water in a sponge. The glymphatics must be stimulated, or at least not impeded, to initiate drainage or flushing. This often occurs during REM sleep.

The brain holds approximately 40% of the eight liters of lymphatic fluid produced daily, making glymphatic drainage crucial to our health. Researchers are investigating whether manual lymphatic drainage applied at the base of the neck and upper chest can enhance the movement of fluid out of the head or brain.

Astronauts experience disrupted sleep and an erratic circadian rhythm, and their resulting brain edema can take over two years to reduce. Patients sleeping in recliners or “taco beds” may also experience a decreased clearance of fluid and particles, like protein, from the brain. A study on astronaut sleep and glymphatic drainage could help doctors better support aging brains and patients who are unable to experience optimal sleep conditions.

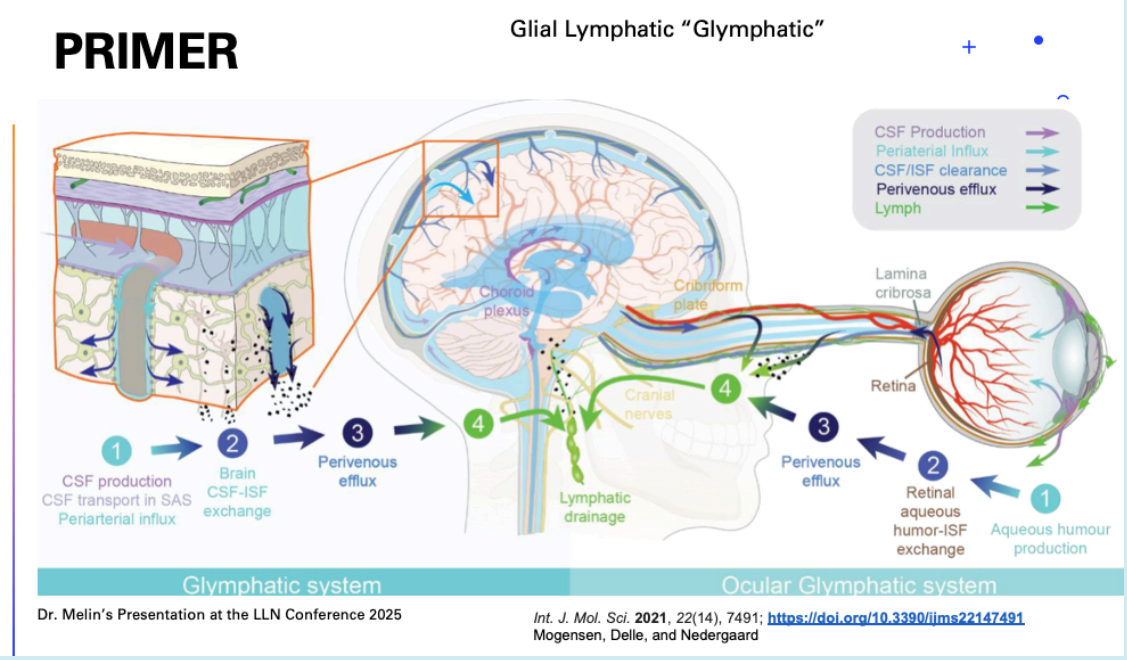
Conference attendees asked about sleep position, pillows, and astronaut sleeping arrangements. Dr. Melin has found that, “Right side sleeping slightly distends the right jugular vein; this 'initiates' glymphatic flushing as this creates slight distension of the intracranial venous system.” Sleeping on either side is considered beneficial for the glymphatics. He is, “Not sure that any pillow has been truly scientifically proven to be most beneficial compared to others in a rigorous trial. Astronauts sleep in a contained sleep sack like a sleeping bag - no pillows used as they are literally floating.”

The **endothelial glycocalyx** layer lines all vessels of the circulatory system. A healthy endothelial glycocalyx allows fluid to flow in one direction - out into the interstitial tissue from the capillary beds - but prevents its return to or reabsorption by the venous system. This is the essential component of the Revised Starling Principle, which states that lymphatics (not veins) are responsible for removing most fluid and debris from the body's tissues. Breakdown of the endothelial glycocalyx is a problem in wound care, as well as in other disease processes, such as diabetes and immobility.

An attendee asked about low albumin and lymphedema. Albumin is a component of the endothelial glycocalyx, and low albumin levels can cause vascular leakage, which may contribute to inflammation. To maintain a healthy endothelial glycocalyx, individuals should exercise (or at least move their arms/legs in multiple directions daily), control their blood pressure and blood sugar levels, and minimize salt intake, smoking, and alcohol consumption. Dr. Melin’s short video describing the endothelial glycocalyx is linked below.

~Reviewed by Sharon Shepard, Editor

The Endothelial Glycocalyx Explained (4 minute video)



Dr. Melin’s Presentation at the LLN Conference 2025

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