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Major finding in human anatomy has implications for many brain diseases, including Alzheimer's

By David Kohn, *The Washington Post*

Kari Alitalo had studied lymphatic vessels for more than two decades. So he knew that this network, which carries immune cells throughout the body and removes waste and toxins, didn't extend into the brain: This had been accepted wisdom for more than 300 years. "Nobody questioned that it stopped at the brain," says Alitalo, a scientist at the University of Helsinki in Finland.

Three years ago, Alitalo wanted to develop a more precise map of the lymphatic system. To do this, he used genetically modified mice whose lymphatic vessels glowed when illuminated by a particular wavelength of light. (The mice had been given a gene from a species of glowing jellyfish.)

When viewing the modified mice under the light, Aleksanteri Aspelund, a medical student in Alitalo's laboratory, saw something unexpected: The heads of the mice glowed. At first, he suspected that there was something wrong – with the animals, the lighting or the measuring equipment. But when Alitalo and Aspelund repeated the experiment, they got the same result. It seemed that the lymphatic vessels extended to the brain after all.

This was surprising, to say the least: In the 21st century, major findings involving basic human anatomy are rare. "These days, you don't make discoveries like this," Alitalo says. "But every once in a while in science, you stumble on something really unexpected. You open a new door, to a whole new world."

Alitalo is one of several scientists exploring this new world. Working independently, several other researchers, including Maiken Nedergaard of the University of Rochester and Jonathan Kipnis of the University of Virginia School of Medicine, have also shown that lymphatic vessels extend into the brain.

The discovery is much more than a historical footnote. It has major implications for a wide variety of brain diseases, including Alzheimer's, multiple sclerosis, stroke and traumatic brain injury.

Researchers have identified two networks: the vessels that lead into and surround the brain, and those within the brain itself. The first is known as the lymphatic system for the brain, while the latter is called the glymphatic system. The "g" added to "lymphatic" refers to glia, the kind of neuron that makes up the lymphatic vessels in the brain. The glymphatic vessels carry cerebrospinal fluid and immune cells into the brain and remove cellular trash from it.

Alitalo, Nedergaard, Kipnis and others have found evidence that when the systems malfunction, the brain can become clogged with toxins and suffused with inflammatory immune cells. Over decades, this process may play a key role in Alzheimer's disease, Huntington's disease, Parkinson's disease and other neurodegenerative illnesses, research suggests. "This is a revolutionary finding," Nedergaard says. "This system plays a huge role in the health of the brain."