



# Update—Brain- Immune Link

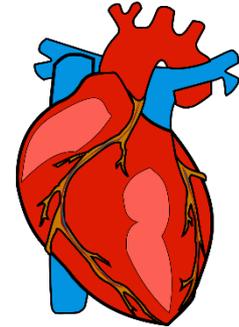
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Brain References  
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# Vascular System

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**The heart pumps blood throughout the brain and body through blood vessels:**

- **Arteries, Veins, and Capillaries**

**Depending on the size and weight of the individual, there may be 60,000 – 100,000 miles of blood vessels**

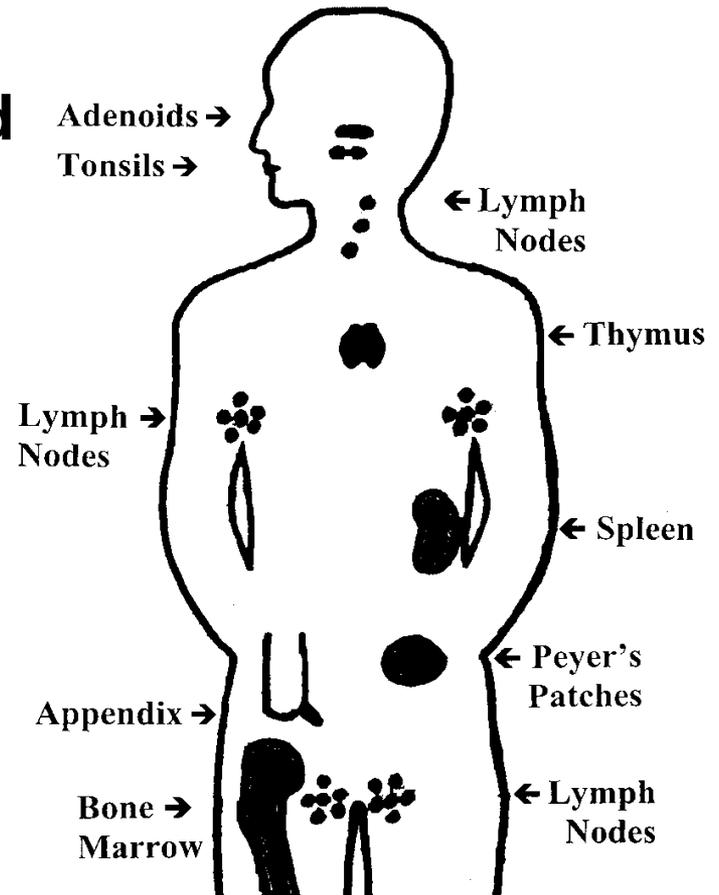
**Blood pressure measures the pressure of blood in mm of mercury against these muscle-lined vessels**

# Immune System

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**Lymph vessels are thin-walled valved structures—slightly larger than their capillary counterparts in the vascular system—that carry lymph fluid throughout the body**

**Based on the size and weight of the person there may be 200,000 to 250,000 miles of lymph vessels**



# Brain-Immune Connection

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**The prevailing belief as been:**

- **There is no direct connection between the brain and the immune system**
- **The brain is only connected with the immune system via immune messengers that are carried in the blood stream (white blood cells, natural killer cells, enkephalins...)**



# Puzzling Observations

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**Puzzling observations: whatever impacted the brain also tended to impact the immune system**



**Strategies to strengthen the brain tended to strengthen the immune system, as well**

**The brain and the immune system have their hands shoved so deeply in each other's pockets that it's hard to tell who is who and which is which**

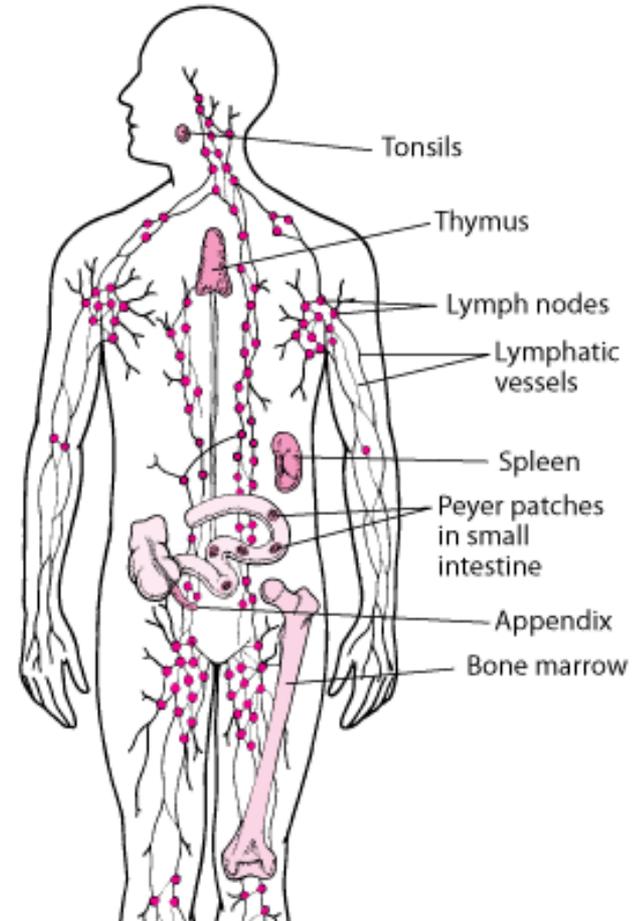


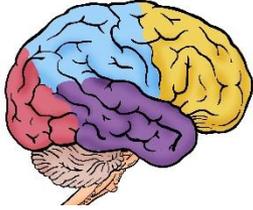
# Brain – Immune System

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**Lymph vessels go throughout the body, passing through lymph nodes**

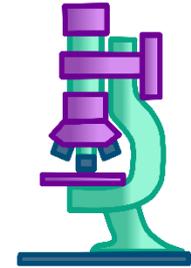
**Textbook drawings of the Brain and Immune System showed no connections between the two except for immune messengers carried in the blood stream (killer cells, antibodies, etc)**





# Late 2015 ...

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**University of Virginia School of Medicine researchers led by Jonathan Kipnis MD, a professor in Department of Neuroscience and Director of the University's Center for Brain Immunology and Glia, were 'dissecting brains'**

**Antoine Louveau, a postdoctoral fellow in Kipnis' lab, saw something he had never seen before**

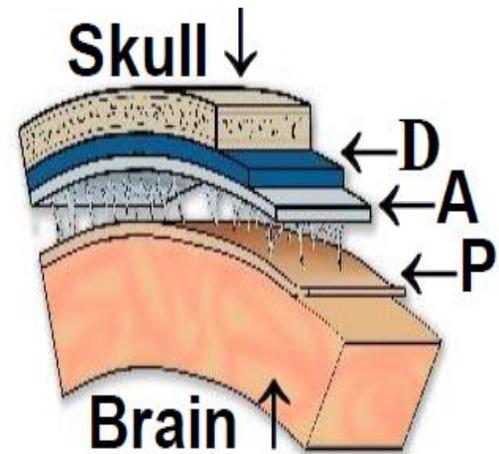
**Antoine asked Dr. Kipnis to take a look at what he was seeing**

# Dr. Kipnis Looked

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He saw lymph vessels going throughout the meninges, the three membranes that cover the brain and spinal cord: Dura mater, Arachnoid mater, Pia mater

Dr. Antoine Louveau's stunning discovery overturns decades of textbook teaching — the brain is directly connected to the immune system by lymphatic vessels *previously thought not to exist*



# New Discovery!

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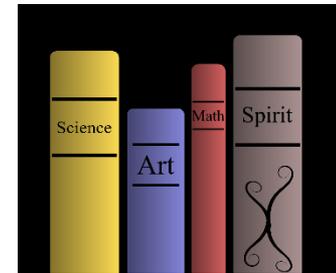
**Prior to late 2015, the belief was that there was no lymphatic system for the brain and central nervous system—there was one, just no one had discovered it**

**Dr. Kipnis said: “I really did not believe there were structures in the body that we were not aware of. I thought the body was mapped... This changes entirely the way we perceive the neuro-immune interaction . . . We believe that for every neurological disease that has an immune component, these vessels may play a major role.”**

# Kevin Lee

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**Kevin Lee, chair of the Department of Neuroscience, recalled his reaction when researchers told him about the new discovery**



**“I just said one sentence: ‘They’ll have to rewrite the textbooks.’**

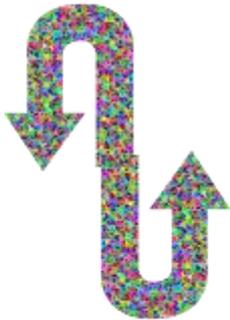
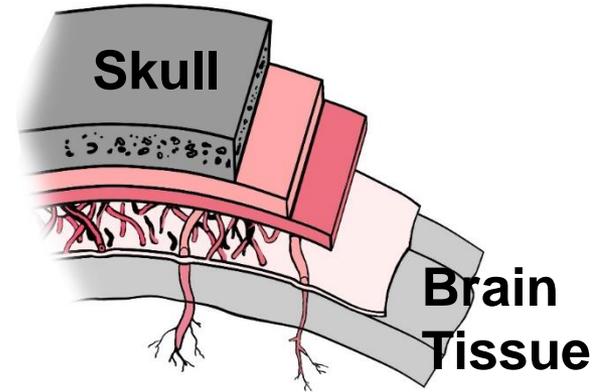
**“It is very clear that this will fundamentally change the way people look at the central nervous system’s relationship with the immune system.”**

# Scrambling to Re-write

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**Due to this new discovery:**

- **Authors are scrambling to re-write textbooks, articles, and Internet resources**
- **Clinicians are taking a closer look at diseases that are believed to have auto-immune components and asking questions regarding bi-directional linkages between the brain and the immune system**



# More Questions to Answer

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**There is an array of neurological diseases, from autism and multiple sclerosis to dementia and Alzheimer's that need to be reconsidered in light of the presence of something science did not know about or even believe existed**

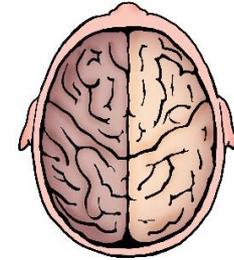


**According to Dr. Kipnis, “In Alzheimer's, there are accumulations of big protein chunks in the brain... that may be accumulating because they're not being efficiently removed by these lymph vessels.”**



# More Discoveries

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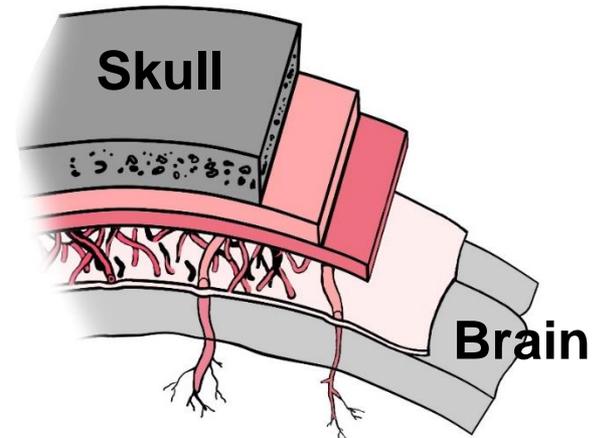
**Studies in late fall of 2015 showed that the brain and immune system are literally and physically connected with each other**

**Fast forward to July of 2016 – According to Jonathan Kipnis MD, study results are showing not only that the brain and immune system are connected but also that some behavior traits may be developed and exhibited because of the immune response to pathogens**

# Brain-Immune Connection

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**Part of your personality may actually be dictated by your immune system linking your brain and pathogens—for example:**



- **Ongoing chronic stress may affect immune cells in the brain, leading to mental disorders**
- **Protective immune microglia cells have direct involvement in creating the cellular networks at the core of brain behavior**

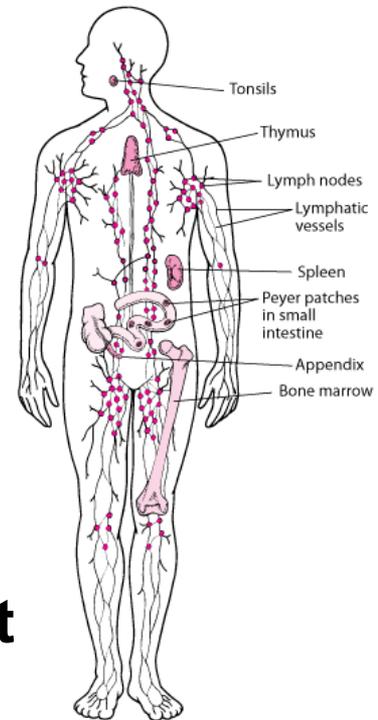
# Grief and Depression

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**Sadness is the emotion that arises in response to a loss . . . those who are grieving are often sad, which can lead to depression**

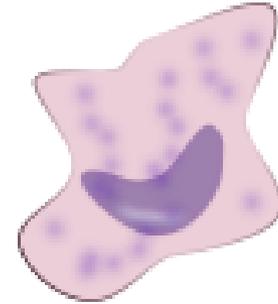
**Prolonged grief can lead to alterations in immune system functions**

- **Cytokines are proteins released by immune system cells that regulate immune responses**
- **Proinflammatory cytokines coordinate inflammation processes in the body**



# PICs

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**Increased levels of proinflammatory cytokines or PICs have been linked with depressive symptoms, including: dysphoria (opposite of euphoria), anhedonia, fatigue, apathy, and a sense of helplessness**

**People with depression have increased levels of preinflammatory cytokines—this may help to explain the reason inflammatory diseases and autoimmune diseases are often associated with depression, as well**

# Grief Recovery

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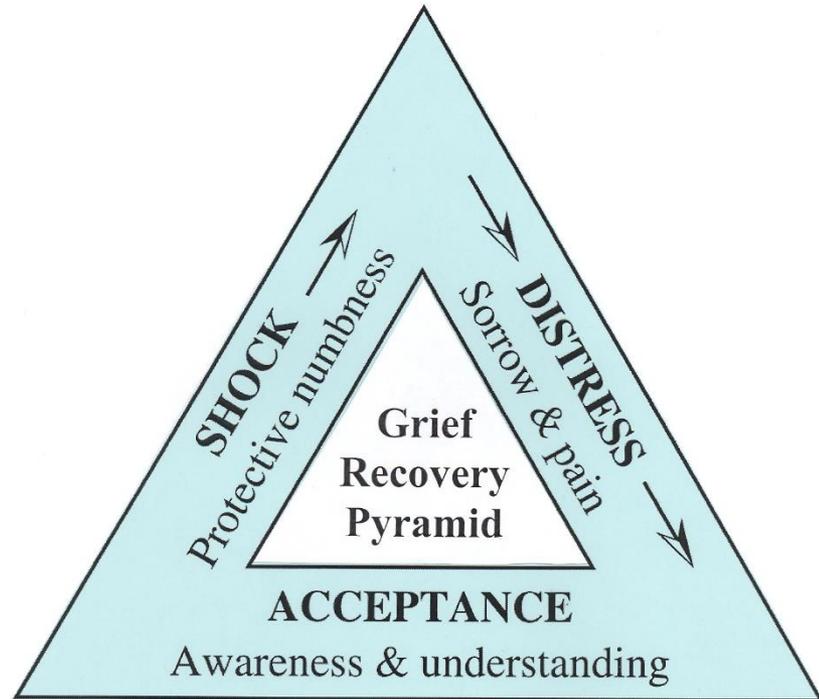
**Grief is the appropriate response to a loss—  
every brain is unique  
and so is its loss-grief  
recovery experiences**

- **Article:**

***Grief Recovery  
Pyramid***

- **Mini-monograph**

***Loss, Grief,  
and Recovery***



# Observations Validated

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**Back to those puzzling observations:  
whatever impacted the brain also  
tended to impact the immune system**



**Strategies to strengthen the brain  
tended to strengthen the immune system, as well**

**Current studies have validated the anecdotally  
observed connections between the nervous  
system and the immune system: increase the  
health of one and you tend to increase the health  
of the other**