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How Many Circulatory Systems Exist in the Brain? Are there Circulatory Systems Which are Responsible for Brain's Fluid Draining?

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Editorial

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INTRODUCTION

If we follow the anatomy manuals we can obtain the wrong picture that the brain has not draining system because of lack of lymphatic vessels. According to the common knowledge to date, the nervous system has only one circulatory system as blood circulatory system but without lymphatic circulatory system. Is that true or there are more circulatory systems in the brain and in the nervous system as a whole?

The aim of this mini-review is to find out the answers of these questions in order to clarify the morphological and functional hallmarks of the brain's circulatory systems and fluids.

HISTORY

Recently, world news were that a team of 12 scientists led by Antoine Louveau (Louveau et al.), pretended that they "discovered functional lymphatic vessels lining the dural sinuses" in the brain^[1]. One of the most important conclusions of this team is the existence of lymphatic system in the brain and "the discovery of central nervous system lymphatic system may call for a reassessment of basic assumptions in neuroimmunology and sheds new light on the aethiology of neuroinflammatory and neurodegenerative diseases associated with immune system dysfunction".

The claim of Louveau and colleagues immediately provoked a response in "Nature" made by Dr. Eva Mezey from the National Institute of Dental and Craniofacial Research, Bethesda, Meryland, USA, and Dr. Miklos Palkovits from Semmelweis University, Budapest, Hungary, reminding that "the first description of lymphatic circulation in the head was soon forgotten". They remind that the earliest data for brain lymphatic system was made by Schwalbe in 1869 and by Brierly and Field in 1948. Moreover, there is a Hungarian group led by Endre Csanda and Michay Földi which described the existence of lymphatic system in the central nervous system in the 1960s (Mezey and Palkovits, 2015)^[2].

All these data shows actually that the brain has two circulatory systems as blood circulatory system and lymphatic circulatory system which supply and drain the brain's covers and brain's tissues. But, this is not the whole truth concerning brain anatomy and its circulatory systems. If the subjects of discussion are the circulatory systems in the brain, we may repeat the previously written sentence that something "was soon forgotten". There is a new circulatory system as Primo Vascular System (PVS) which is distributed and has network in the entire body including the central nervous system, brain and its meninges.

PVS was observed in brain ventricles^[3-7], in subarachnoidal space, in pia mater^[8], superior sagital sinus (SSS)^[9,10]. PVS carries out fluid but with different substances than lymph and blood. It is very interesting that SSS is a place where different teams of scientists found blood vessels, lymph vessels and primo vessels^[1,8,9]. In fact, SSS is converting as a place with bundle of blood, lymphatic, and primo vessels. It is very surprising that Figure 1 made by Nam et al. and Figure 10 made by Louveau et al. are very similar^[1,9].

CONCLUSION

Finally, after analyzing the existing data, we can conclude that brain has three circulatory systems as well as any other organ in the body. The lymph system and PVS as a part of the brain circulatory systems are responsible for brain's draining but with different type of fluids. SSS is a part of the brain with bundle of vessels as well as arteriole, venule, lymphatic and primo vessels. This topography place situated laterally and underneath of SSS which is consisting of bundle of different vessels is a very good base for giving new meaning of the brain's morphology and physiology.

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