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New insights in movement of cerebrospinal fluid in relation to craniosacral therapy

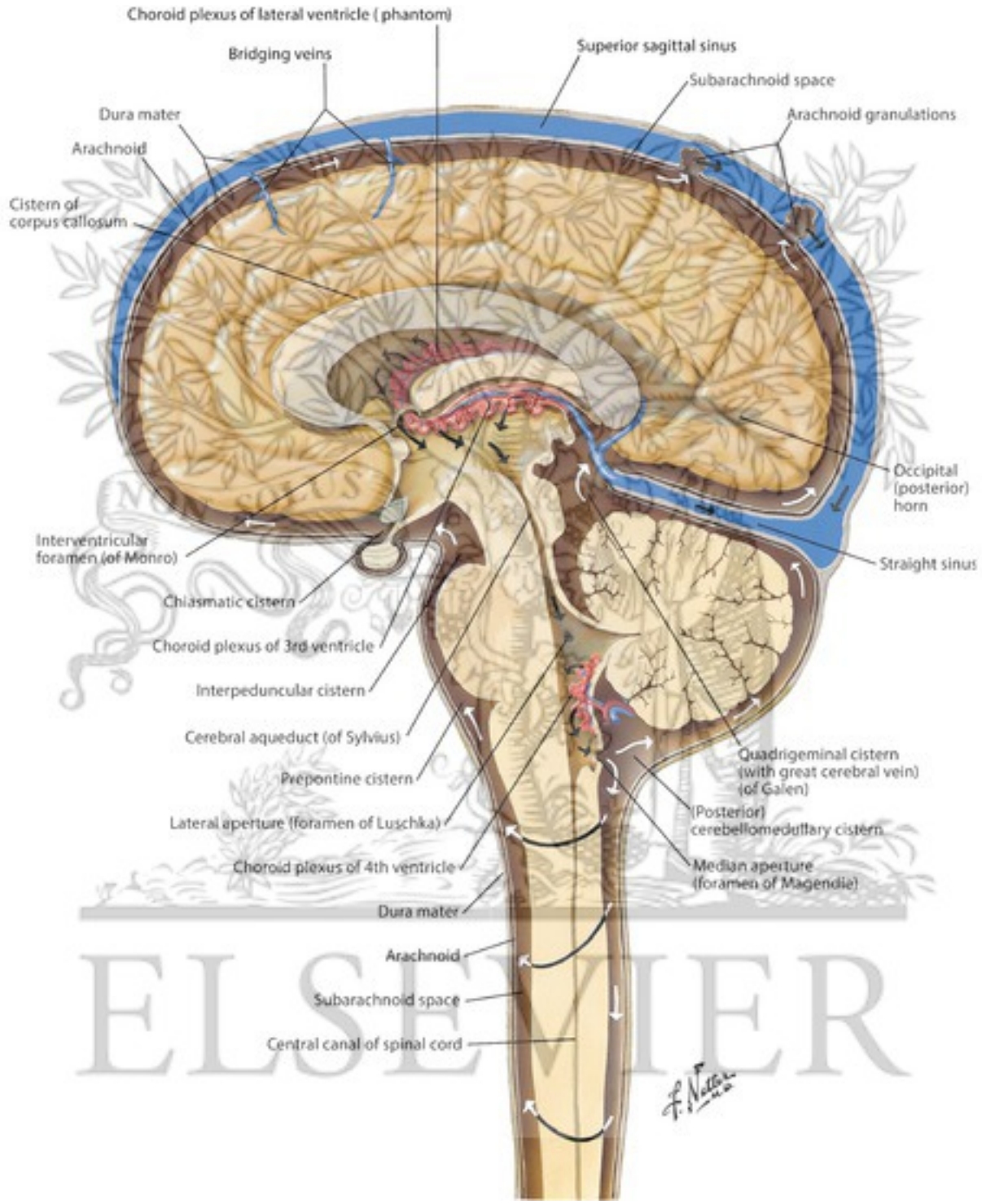
- by Willem P. VisserFebruary 5, 2019

The Circulation of cerebrospinal fluid plays a major role in craniosacral therapy. As a craniosacral therapist makes through touch contact with rhytmical motions related to the flow of cerebrospinal fluid. New scientific insights show the “circulation” or maybe better “movement” of cerebrospinal fluid is *much more complex* than previously understood. This article summarizes the

latests scientific developments on cerebrospinal fluid and the implications of this for craniosacral therapy.

Traditional understanding of cerebrospinal fluid circulation

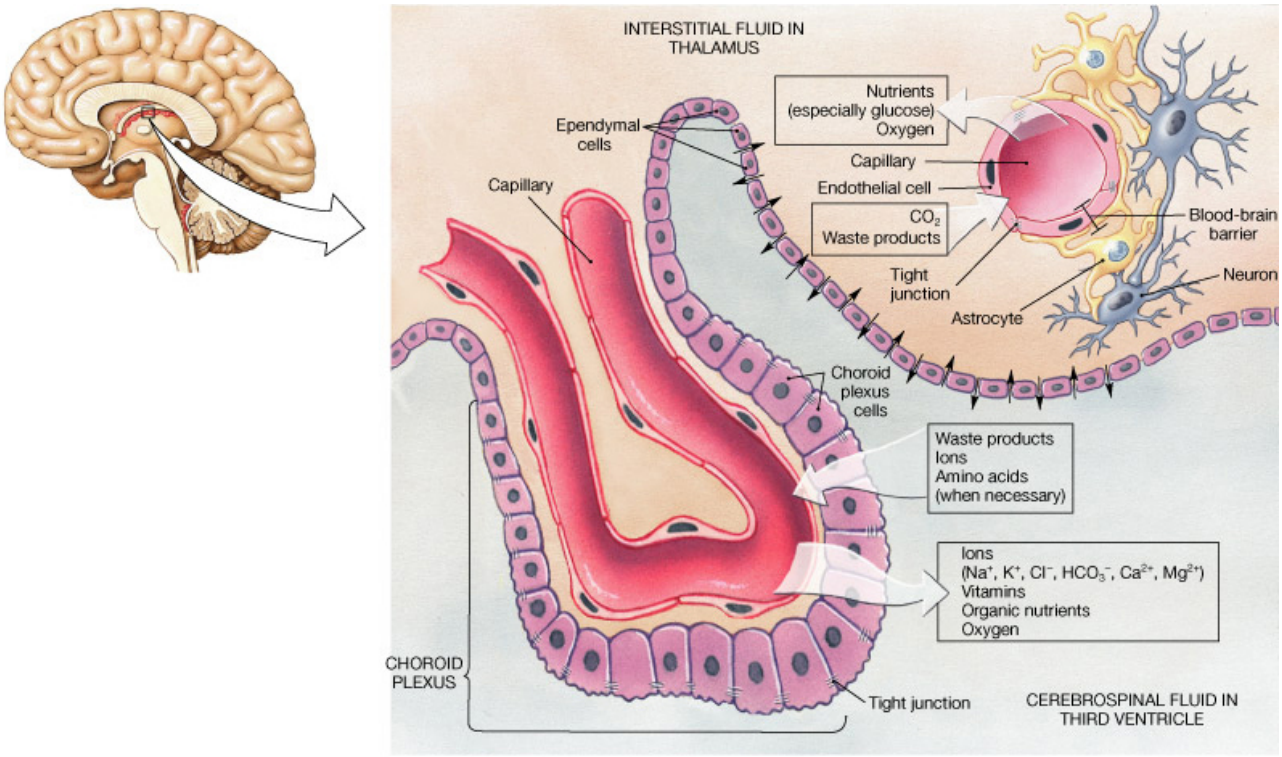
How the cerebrospinal (CSF) fluid moves through the brain according to the traditional view is explained the best in below picture from Netter's anatomy atlas. The cerebrospinal fluid moves at the choroid plexus through the blood brain barrier into the brain ventricles. The fluid circulates through the ventricles, the cistern, and the subarachnoid space to be absorbed into the blood by the arachnoid villi (1).



Circulation of cerebrospinal fluid, plate 160 in Netter's anatomy atlas (2)
As Netter's picture shows with the arrows, it assumes an uni-directionals flow of the cerebrospinal fluid. This circulation of cerebrospinal fluid is the traditional scientific viewpoint and has been taught to many people in anatomy classes for decades.

Most of the cerebrospinal fluid is formed in the ventricles. The historically view is that the choroid plexus are the major site of creation for CSF fluid. This was based on an experiment that the

American neurosurgeon Walter Dandy did in 1913 on a single dog (1). He removed the choroid plexus of the poor dog in one lateral ventricle and occluded the canal between the lateral ventricle and the third ventricle (foramen of Monro). He reported collapse of the ventricle without the choroid plexus and dillation of the other



Choroid Plexus and Ependyma

ventricle (1,3). From this he concluded that CSF fluid was formed in the choroid plexus. This was supported by another experiment that showed that hematocrit of the blood in the choroid plexus was 1.15 greater than normal blood. This because they assumed fluid from the blood was secreted into the ventricles. And this secretion value corresponded to an estimated rate of total CSF absorption (1). From other study in 1967 it was suggested that around 30% of the CSF fluid was created in ependyma (1). Ependymal cells form a thin line across the ventricles and spinal chord. The choroid plexus is actually a structure combined of modified ependymal cells and capillaries sticking out into the ventricles.The arachnoid villi have historically been located as place of *absorption* of CSF fluid back into the blood. This was actually based on experiments in Sweden by mister Key and mister Gustaf Retzius in 1875 (1). They injected colored gelatin into the CSF spaces of human cadavers and reported the distribution of the dye throughout the whole CSF

system and its passages accross the arrachnoid villi into the sinuses. Another gentleman in 1914, mister Weed questioned these results, because the pressure used for the injection might have been too high. So he repeated the experiment with different dyes and lower pressure. He though came to a similar conclusion. More important he also stated ‘no evidence has been afforded in our observations of cerebrospinal fluid into cerebral veins or capillaries’ (1). This would also be unlogical in some sense because blood pressure is significantly higher than cerebrospinal fluid pressure. So hydrodynamic pressure would not push CSF fluid into capillaries. The other option of absorption into the capillaries through osmotic pressure was also disregarded in a research on cats (1).

Only one alternative pathway of absorption was already detected in the 1951 and that was absorption of CSF fluid into the cervical lymphatics (1). There are subarchanoid spaces surrounding the cranial nerves, like the olfactory nerve connected to the cranial CSF space. Initially it was found that only 5% of the CSF fluid was absorbed into the lymphatic channels. Later research on rabbits showed an absorption rate of 50%.

In 1926 a famous American neurosurgeon Harvey Cushing (you might have heard of Cushing’s disease) put the formation and absorption of CSF fluid together in the concept of the ‘third circulation’ (1). So this is in a nutshell how scientists came to the classical understanding of the circulation of cerebrospinal fluid through the ventricles, cistern, subarchanoid spaces and absorption back into the blood in the arachnoid villi. This hypothesis is still the accepted view by the majority of the researchers today and shown in the above Netter image. However even back in the days researchers were still very cautious about their understanding of the cerebrospinal fluid. The before mentioned Sir Weed wrote in 1935: “*…..to-day we know so little more of the essential function of the fluid than we knew a quarter of a century ago. Yet we have become somewhat more certain as to how and where the fluid is produced, somewhat more certain as to how and where the fluid is returned to the venous system, somewhat more certain as to how and where the nervous system is protected by the three membranes and craniovertebral container. But there is still much*

to be learned about the meninges and cerebrospinal fluid-the problem must still be followed with equal regard for structure and function." (4) The same could still be written more than 80 years later. In the next part of this post it will be shown that the reality indeed appears to be much more complex than the "third circulation" shows. READ FURTHER**>>>>>**

References

1. Brinker T, Stopa A, Morrison J and Klinge P: **A New Look at cerebrospinal fluid circulation** *Fluids and Barriers of the CNS* 2014 **11**:10 http://www.ncbi.nlm.nih.gov/pubmed/24817998

2. Netter FH, **Atlas of Human Anatomy**, 4th edition, Sunders Elsevier, 2006, ISBN-13: 978-1-4160-3385-1

3. Dandy WE, Blackfan KD: **An experiment and clinical study of internal hydrocephalus.** *JAMA* 1913, **61:**2216-2217

4. Weed LH, **Meninges and cerebrospinal fluid**, *Brain* 58:583-97 1935