

Clinical significance and structure of cerebrospinal fluid.

John Harahap*

Department of Medicine and Science, University of Freiburg, Freiburg, Germany

Abstract

Cerebrospinal fluid (CSF) is an ultra-filtrate of plasma contained within the ventricles of the brain and the subarachnoid spaces of the cranium and spine. It performs vital functions, including providing nourishment, waste removal, and protection to the brain. Adult CSF volume is estimated to be 150 ml, with a distribution of 125 ml within the subarachnoid spaces and 25 ml within the ventricles. CSF is predominantly secreted by the choroid plexus with other sources playing a more poorly defined role. In the adult population, its secretion varies between individuals, usually ranging from 400 to 600 ml per day.

Keywords: Cerebrospinal fluid (CSF), Lumbar puncture, Depression, Cranium, Spine, Circulation.

Introduction

The analysis of CSF obtained by lumbar puncture gives clues to various disease processes. In healthy individuals the fluid is normally crystal clear and colourless. However, it will contain blood if subarachnoid haemorrhage has occurred. The presence of white blood cells or bacteria is indicative of infection. Viral meningitis can be differentiated from bacterial meningitis by the type of white blood cells identified in the CSF. In addition, culturing a sample of the fluid to determine whether bacteria are present is an effective way to distinguish between different causes of meningitis. Fluctuations in CSF glucose and protein levels also are important indicators of disease. For example, the amount of protein in CSF is increased in individuals with meningitis or a tumour [1].

Structure

Circulation: There is about 125–150 mL of CSF at any one time. This CSF circulates within the ventricular system of the brain. The ventricles are a series of cavities filled with CSF. The majority of CSF is produced from within the two lateral ventricles. From here, CSF passes through the interventricular foramina to the third ventricle, then the cerebral aqueduct to the fourth ventricle. From the fourth ventricle, the fluid passes into the subarachnoid space through four openings – the central canal of the spinal cord, the median aperture, and the two lateral apertures. CSF is present within the subarachnoid space, which covers the brain, spinal cord and stretches below the end of the spinal cord to the sacrum. There is a connection from the subarachnoid space to the bony labyrinth of the inner ear making the cerebrospinal fluid continuous with the perilymph in 93% of people. CSF moves in a single outward direction from the ventricles, but multidirectional in the subarachnoid space. Fluid movement is pulsatile, matching the pressure waves generated in blood vessels by the beating

of the heart. Some authors dispute this, posing that there is no unidirectional CSF circulation, but cardiac cycle-dependent bi-directional systolic-diastolic to-and-from cranium-spinal CSF movements [2, 3]

Clinical significance

Hydrocephalus is a pathological condition of abnormal accumulation of CSF caused by increased CSF production, blockage of flow, or decreased absorption. The ventricles distend in order to accommodate elevated CSF volumes, potentially causing damage to the brain by pressing its tissue against the bone skull. Hydrocephalus may be congenital or acquired [4].

CSF Leak is a condition in which CSF is able escape from the subarachnoid space through a hole in the surrounding Dura. The volume of CSF lost in a leak is very variable, ranging from insignificant to very substantial amounts.

Syringomyelia due to blockage of CSF circulation.

Meningitis is a condition in which the coverings of the brain become inflamed. There are two classifications of meningitis: aseptic and bacterial. Aseptic meningitis can be caused by agents such as fungi, medications, and cancer metastasis, but the majority of aseptic meningitis cases are caused by viruses. Fever, nuchal rigidity, and photophobia are classic presenting symptoms. Diagnosis is made via an analysis of CSF obtained through LP.

Subarachnoid Haemorrhage (SAH) is the leakage of blood into the subarachnoid space where it mixes with the CSF. SAH is most commonly caused by trauma with 80% of nondramatic SAHs being caused by aneurysm rupture. Other nondramatic causes of SAH include arteriovenous malformations and vacuities.

*Correspondence to: John Harahap, Department of Medicine and Science, University of Freiburg, Freiburg, Germany, E-mail: hapjohn@gmail.com

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Lumber Puncture and CSF Analysis - Lumbar puncture is a sterile procedure, done to obtain CSF samples for diagnostic purposes. It involves passing a needle into the subarachnoid space at the levels between L2 and L5 vertebrae. However, most commonly lumbar puncture is performed between L4 and L5. Biochemical, microbiologic and cytological studies are then carried out on the sample [5].

Conclusion

The presence of infection or a tumour is also indicated by elevated fluid pressure. The constant secretion of CSF contributes to complete CSF renewal four to five times per 24-hour period in the average young adult. The reduction of CSF turnover may contribute to the accumulation of metabolites seen in aging and neurodegenerative diseases. The composition of CSF is strictly regulated, and any variation can be useful for diagnostic purposes.

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