

## Commentary

### THE ENIGMA OF THE THIRD CIRCULATION

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### Abstract

Obstacles involved in resolving the enigma of the third circulation.

### Introduction

Since Francois Magendie in 1825 described the existence of the circulation of cerebrospinal fluid (CSF) with his measurements of CSF pressure, and after Harvey Cushing introduced the term “the third circulation” for the CSF circulation in 1926, much progress in research has been made; but the mechanism of CSF hydrodynamics is still an enigma.

### Discussion

There are major obstacles to a complete resolution to the enigma of the third circulation:

- (1) *Shortcomings in the current knowledge*, e.g.: gaps [1], inconsistencies [2, 3], controversies [4], interpretations of important findings [5-7], (re)definition of Monro-Kellie doctrine [8, 9], etc.
- (2) *Lack of appropriate techniques*: unavailability of techniques for direct noninvasive dynamic measurements: separately for total CSF formation during CSF pressure variations, and separately for total CSF removal during CSF pressure variations and their distributions along the CSF space [9],
- (3) *Money investments in research*: I believe that the total cost of a complete resolution of the enigma of CSF hydrodynamics would be extremely high.

It is a time when basic questions about CSF hydrodynamics are being reopened again. The classical hypothesis based on constant CSF formation during CSF pressure variations and CSF removal linearly dependent on CSF pressure – the latter starts at the hydrostatic blood pressure in the venous sinus sagittalis superior as the predominant site of CSF removal – is now more and more challenged. There is considerable evidence which is not consistent with it [2, 3]. Some important findings

could have new interpretations e.g.: (1) self sustained high CSF pressure with zero (net) CSF flow, zero CSF formation and zero CSF removal (discussion with Mary E. Kerr) [7], (2) intracranial hypotension caused by decreased CSF formation (correspondence to Maria I. Argyropoulou) [7].

Rigorous analysis shows that there are many definitions of the Monro-Kellie doctrine. I believe, however, that we need a new one which would be an accurate and a universally accepted definition for further CSF investigations. The definition should involve all intracraniovertebral (craniospinal) constituents [9].

Furthermore, I believe that we need new techniques for CSF hydrodynamics research. It is said, namely, that the progress in scientific discoveries is basically the progress in discoveries of new scientific techniques. Last but not least, to resolve its enigma, funding of basic research in CSF hydrodynamics could be very demanding.

## Conclusions

Author presents his point of view about the enigma of the third circulation in a very short form. Statements need further elaboration and discussion.

## Competing interests

The author declares that no conflict of interest exists.

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