

# Post-neurosurgical meningitis diagnosis

[Post-neurosurgical meningitis](#) (PNM) often leads to serious consequences; unfortunately, the commonly used clinical diagnostic methods of PNM are time-consuming or have low specificity.

Due to the excessive [neuroinflammation](#) which are evoked by the primary brain [disease](#) or the [craniotomy operation](#), the [symptoms](#) derived from the [infection](#) and aseptic may not be easily distinguished. On the other hand, the low positive rate and time-consuming character restrict the clinical practical values of [microbiological culture](#). Therefore, it is always difficult to make a definite diagnosis of post-neurosurgical bacterial meningitis. Bao et al. reviewed the established literature about the diagnostic biomarkers for the post-neurosurgical [bacterial meningitis](#) (PNBM) and analyzed the potential obstacles in both clinical and scientific studies. Given the obstacle which has negative impacts on further investigation about the biology of PNBM, they only find relatively small numbers of study on PNBM <sup>1)</sup>

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Suspected internal external ventricular drain (EVD)-related infections could represent sterile inflammation or lower bacterial load leading to false-negative cultures. There is a need for improved microbiology diagnostics and biomarkers of bacterial infection to permit accurate discrimination and improve antimicrobial stewardship <sup>2)</sup>.

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To realize the accurate and convenient diagnosis of PNM, Xie et al. proposed a [comprehensive strategy](#) for [cerebrospinal fluid analysis](#) based on a machine-learning-aided [Cross-Reactive Chemical Sensor Array](#). The [sensor array](#) involves three Eu<sup>3+</sup>-doped metal-organic frameworks (MOFs), which can generate specific [fluorescence](#) responding patterns after reacting with potential targets in CSF. Then, the responding pattern is used as learning data to train the [machine learning algorithms](#). The discrimination confidence for artificial CSF containing different components of molecules, proteins, and cells is from 81.3 to 100%. Furthermore, the machine-learning-aided sensing array was applied in the analysis of CSF samples from post-neurosurgical patients. Only 25  $\mu$ L of CSF samples was needed, and the samples could be robustly classified into "normal," "mild," or "severe" groups within 40 min. It is believed that the combination of machine learning algorithms with robust data processing capability and a lanthanide luminescent sensor array will provide a reliable alternative for more comprehensive, convenient, and rapid diagnosis of PNM <sup>3)</sup>.

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A study suggests that raised cerebrospinal fluid tumor necrosis factor - $\alpha$ , interleukin-1 $\beta$ , and interleukin-8 in a temporal manner may indicate early bacterial meningitis development in neurosurgical patients, enabling earlier diagnostic certainty and improved patient outcomes <sup>4)</sup>.

1)

Bao MY, Xie HT, Gao P, Mao X, Li ZY, Wang WH, Sopheak S, Cheng HW, Ye L, Zhang X. Current diagnosis and potential obstacles for post-neurosurgical bacterial meningitis. *Eur Rev Med Pharmacol Sci*. 2022 Sep;26(17):6351-6360. doi: 10.26355/eurrev\_202209\_29661. PMID: 36111937.

2)

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Sohn SY, Russell CD, Jamjoom AAB, Poon MT, Lawson McLean A, Ahmed AI; British Neurosurgical Trainee Research Collaborative. Comparison of Suspected and Confirmed Internal External Ventricular Drain-Related Infections: A Prospective Multicenter United Kingdom Observational Study. *Open Forum Infect Dis.* 2022 Sep 17;9(10):ofac480. doi: 10.1093/ofid/ofac480. PMID: 36267249; PMCID: PMC9578167.

3)

Xie R, Song X, Chen H, Lin P, Guo S, Zhuang Z, Chen Y, Zhao W, Zhao P, Long H, Tao J. Intelligent Clinical Lab for the Diagnosis of Post-Neurosurgical Meningitis Based on Machine-Learning-Aided Cerebrospinal Fluid Analysis. *Anal Chem.* 2022 Nov 7. doi: 10.1021/acs.analchem.2c03154. Epub ahead of print. PMID: 36341721.

4)

Liu ZH, Tu PH, Chen NY, Yip PK, Bowes AL, Lee CC, Chan SH, Kung CC, Wang AY, Wu CT, Lee ST. Raised Proinflammatory Cytokine Production Within Cerebrospinal Fluid Precedes Fever Onset in Patients With Neurosurgery-Associated Bacterial Meningitis. *Crit Care Med.* 2015 Jul 20. [Epub ahead of print] PubMed PMID: 26196350.

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