

Answer to Medical Quiz - 1

Answer

- (I)A left parietal cystic tumor, surrounded by cerebral edema, showing ring enhancement following contrast administration (B)
(II)C, D DWI and ADC sequences show High DWI and low ADC ($600 \times 10^6 \text{ mm}^2 \text{ s}^{-1}$, arrow) throughout the lesion
- Cerebral abscess
- Differentials: primary necrotic tumours, tuberculoma, cerebral metastases.
- MRS shows (E,F) high lipid as well as the presence of amino acid, acetate and succinate peaks .
- These characteristic MRS findings in combination with the very low ADC are diagnostic of abscess.
- Diagnosis was confirmed on aspiration

Discussion:

- Cerebral abscesses account for 1–8% of intracranial mass lesions ¹. Diagnosis can be challenging as abscesses on conventional imaging can mimic primary necrotic tumours and metastases. By using MRS and DWI, the sensitivity/specificity for diagnosis is up to 100% ^{2, 3}.
- Multiparametric MRI features of abscess are uniformly low ADC due to the higher viscosity of fluid. The ADC values are typically less than $700 \times 10^6 \text{ mm}^2 \text{ s}^{-1}$ ⁴, which is lower than expected to be seen in high-grade tumours or metastases ($700\text{--}780 \times 10^6 \text{ mm}^2 \text{ s}^{-1}$).
- In 1H spectroscopy, the major peaks are due to N-acetyl aspartate (NAA), choline-containing compounds (Cho), Cr and myoinositol (ml)⁵.
 - NAA is contained almost exclusively within neurons in adult brain and therefore provides an indication of neuronal/axonal dysfunction, damage, or loss.
 - Cho are prominent in membranes.
 - Myoinositol may act as an osmolyte.
 - Creatine (Cr) is found in cell energy stores
- Smaller peaks from glutamate, glutamine, and α -aminobutyric acid (GABA) may be detectable when short echo times and spectral editing techniques are used. Lactate may appear when anaerobic metabolism is occurring, and peaks due to mobile lipids, which are small in normal brain on short echo studies, may become prominent in acute demyelinating lesions, probably as a result of myelin breakdown.

- 1H-MRS could be useful in distinguishing between different bacteria responsible for the **abscess** and in choosing an appropriate therapy. There are three different spectra to consider⁶:
 - Type A:** presence of lactate, amino acids, alanine, acetate, succinate and lipids related to the presence of obligate anaerobes with or without facultative anaerobes;
 - Type B:** presence of lactate, amino acids and occasionally lipids related to obligate aerobes and facultative anaerobes;
 - Type C:** presence of lactate alone, associated with Streptococcus and with treated abscesses.
- After medical therapy, abscesses show a non-specific peak of lipids and lactate that are also present in cystic tumors. For this reason, it is critical to use spectroscopy before the medical treatment.

References:

- Osenbach RK, Loftus CM. Diagnosis and management of brain abscess. *Neurosurg Clin N Am.* 1992;3:403-420. [https://doi.org/10.1016/S1042-3680\(18\)30671-5](https://doi.org/10.1016/S1042-3680(18)30671-5)
- Hsu S-H, Chou M-C, Ko C-W, et al. Proton MR spectroscopy in patients with pyogenic brain abscess: MR spectroscopic imaging versus single-voxel spectroscopy. *Eur J Radiol.* 2013;82:1299-1307. <https://doi.org/10.1016/j.ejrad.2013.01.032>. PMID:23453705
- Xu X-X, Li B, Yang H-F, et al. Can diffusion-weighted imaging be used to differentiate brain abscess from other ring-enhancing brain lesions? A meta-analysis. *Clin Radiol.* 2014;69:909-915. <https://doi.org/10.1016/j.crad.2014.04.012>. PMID:24933524
- Horvath-Rizea D, Surov A, Hoffmann K-T, et al. The value of whole lesion ADC histogram profiling to differentiate between morphologically indistinguishable ring enhancing lesions-comparison of glioblastomas and brain abscesses. *Oncotarget.* 2018;9:18148-18159. <https://doi.org/10.18632/oncotarget.24454>. PMID:29719596 PMID:PMC5915063
- Aida N. 1H-MR Spectroscopy of the Early Developmental Brain, Neonatal Encephalopathies, and Neurometabolic Disorders. *Magn Reson Med Sci.* 2022 Mar 1;21(1):9-28. doi: 10.2463/mrms.rev.2021-0055. <https://doi.org/10.2463/mrms.rev.2021-0055>. PMID:34421092 PMID:PMC9199977
- Lisserre R, Pinelli L, Gasparotti R. MR spectroscopy in pediatric neuroradiology. *Transl Pediatr.* 2021 Apr;10(4):1169-1200. doi: 10.21037/tp-20-445. <https://doi.org/10.21037/tp-20-445>. PMID:34012861 PMID:PMC8107850