1p/19q Co-deletion

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see Oligodendroglioma.

1p/19q co-deletion is a chromosomal abnormality characterized by the **combined loss of the short arm of chromosome 1 (1p)** and the **long arm of chromosome 19 (19q)**. It serves as a key molecular marker in glioma classification and glioma management.

Clinical Significance

- **Diagnostic**:
  - Defines **oligodendroglioma** when present with **IDH mutation**.
  - Required for diagnosis of “oligodendroglioma, IDH-mutant and 1p/19q-codeleted” (WHO CNS 2021).
- **Prognostic**:
- Associated with **favorable prognosis**.
- Typically indicates **slow-growing**, **chemo- and radiosensitive** tumors.
- **Predictive**:
  - Strongly predicts response to **PCV chemotherapy** and **temozolomide**.

Molecular Mechanism

The co-deletion results from a **whole-arm translocation** between chromosomes 1 and 19 [t(1;19)(q10;p10)], followed by **loss of derivative chromosomes**.

Detection Methods

- **FISH (Fluorescence in situ hybridization)**
- **PCR-based Loss of Heterozygosity (LOH)**
- **Comparative Genomic Hybridization (CGH)**
- **SNP arrays / Next-Generation Sequencing (NGS)**

WHO CNS 2021 Criteria

To classify a glioma as an **oligodendroglioma**, the following criteria must be met:

1. Histology: oligodendroglial morphology
2. Molecular:
    1. **IDH1 or IDH2 mutation**
    2. **1p/19q co-deletion**

> Note: If 1p/19q is not co-deleted, and IDH is mutated, the diagnosis is **astrocytoma, IDH-mutant**.

According to the World Health Organization Classification of Tumors of the Central Nervous System 2021, a tumor cannot be classified as an oligodendroglioma unless it shows both an IDH mutation and the 1p/19q co-deletion.

Why is it important?

Prognosis: Tumors with 1p/19q co-deletion tend to respond better to chemotherapy and radiotherapy.

Survival: Patients with this co-deletion generally have a longer overall survival compared to tumors without it.

Diagnosis: The presence or absence of the co-deletion helps properly classify the type of brain tumor.

How is it detected?

Methods such as FISH (fluorescence in situ hybridization), MLPA (multiplex ligation-dependent probe amplification), or NGS (next-generation sequencing).

1p19q codeletion stands for the combined loss of the short arm chromosome 1 (i.e. 1p) and the long arm of chromosome 19 (i.e. 19q) and is recognized as a genomic marker predictive of therapeutic response to both chemotherapy and combined chemoradiotherapy and overall longer survival in

patients with diffuse gliomas, especially those with oligodendroglial components

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Either deletion or co-deletion of chromosomal arms 1p or 19q is a characteristic and early genetic event in oligodendrogliomas that is associated with a better prognosis and enhanced response to therapy. Information of 1p/19q status is now regarded as the standard of care when managing oligodendroglial tumors for therapeutic options in anticipation of the increased survival and progression-free survival times associated with it.

IDH positive + 1p/19q co-deletion = oligodendroglioma = better prognosis

IDH positive + no 1p/19q co-deletion = astrocytoma [1].

Prediction

As an important genomic marker for oligodendrogliomas, early determination of 1p/19q co-deletion status is critical for guiding therapy and predicting prognosis in patients with glioma. The purpose of this study is to systematically review the literature concerning magnetic resonance imaging (MRI) with artificial intelligence (AI) methods for predicting 1p/19q co-deletion status in glioma. PubMed, Scopus, Embase, and IEEE Xplore were searched in accordance with the Preferred Reporting Items for systematic reviews and meta-analyses guidelines. The methodological quality of studies was assessed according to the Quality Assessment of Diagnostic Accuracy Studies-2. Finally, 28 studies were included in the quantitative analysis. Diagnostic test accuracy reached an area under the ROC curve of 0.71-0.98 were reported in 24 studies. The remaining four studies with no available AUC provided an accuracy of 0.75-0. 89. The included studies varied widely in terms of imaging sequences, input features, and modeling methods. The current review highlighted that integrating MRI with AI technology is a potential tool for determining 1p/19q status pre-operatively and noninvasively, which can possibly help clinical decision-making. However, the reliability and feasibility of this approach still need to be further validated and improved in a real clinical setting. EVIDENCE LEVEL: 2. TECHNICAL EFFICACY: 2 [2]

Indications

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Currently, classification of neoplasms, especially regarding gliomas, is established on molecular mutations in isocitrate dehydrogenase (IDH) genes and the presence of 1p/19q co-deletion [3]

1p/19q co-deletion should be tested whenever oligodendroglial features are present or if oligodendroglioma is suspected on other grounds. This is tested using FISH (fluorescence in situ hybridization) or PCR. It is often sent out, results typically take 3–7 days. Cost for FISH is on the order of $200 U.S., PCR is $300–500 U.S

Oligodendrocyte transcriptional factor-2 (Olig2) is an essential marker for oligodendrocytes expression. Olig2 marker cannot be used as an alternative diagnostic method for 1p 19q co-deletion to distinguish oligodendrogliomas from other glial neoplasms. Although some glial tumors showed diffuse Olig2 expression, 1p19q co-deletion testing is the best diagnostic method [4].

Oligodendroglioma 1p/19q co-deletion

Oligodendroglioma 1p/19q co-deletion.

Anaplastic astrocytoma without 1p/19q co-deletion

Anaplastic astrocytoma without 1p/19q co-deletion.

Extraventricular neurocytoma

1p/19q co-deletion has not been reported in central neurocytoma, but it can be seen in extraventricular neurocytoma.

1)
https://radiopaedia.org/articles/1p19q-codeletion#:~:text=1p19q%20codeletion%20stands%20for%20the,in%20patients%20with%20diffuse%20gliomas%2C
2)
Zhang S, Yin L, Ma L, Sun H. Artificial Intelligence Applications in Glioma With 1p/19q Co-Deletion: A Systematic Review. J Magn Reson Imaging. 2023 Apr 21. doi: 10.1002/jmri.28737. Epub ahead of print. PMID: 37083159.
3)
Casili G, Paterniti I, Campolo M, Esposito E, Cuzzocrea S. The Role of Neuro-Inflammation and Innate Immunity in Pathophysiology of Brain and Spinal Cord Tumors. Adv Exp Med Biol. 2023;1394:41-49. doi: 10.1007/978-3-031-14732-6_3. PMID: 36587380.
4)
Kurdi M, Alkhatabi H, Butt N, Albayjani H, Aljhdali H, Mohamed F, Alsinani T, Baeesa S, Almuhaini E, Al-Ghafari A, Hakamy S, Faizo E, Bahakeem B. Can oligodendrocyte transcriptional factor-2 (Olig2) be used as an alternative for 1p/19q co-deletions to distinguish oligodendrogliomas from other glial neoplasms? Folia Neuropathol. 2021;59(4):350-358. doi: 10.5114/fn.2021.112562. PMID: 35114775.