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Opinion Article

Gene Expression Profiling in Glioneuronal Tumors: Implications for Diagnosis and Treatment

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DESCRIPTION

Glioneuronal tumors, a subset of brain neoplasms characterized by a combination of glial and neuronal elements, present unique challenges in diagnosis and treatment. Understanding gene expression profiles in these tumors can provide valuable insights into their biology, identify potential biomarkers for diagnosis, and suggest new therapeutic targets.

Gene expression in glioneuronal tumors

Gene expression profiling involves analyzing the activity of thousands of genes to provide an extensive view of cellular function.

Identify molecular subtypes: Gene expression analysis can classify glioneuronal tumors into distinct molecular subtypes, each with specific genetic and epigenetic features. These subtypes often correlate with different clinical outcomes and responses to therapy.

Understand tumor biology: By examining which genes are overexpressed or under expressed, researchers can gain insights into the pathways that drive tumor growth and progression.

Discover therapeutic targets: Gene expression studies can reveal specific genes or pathways that are critical for tumor survival, providing potential targets for new therapies.

Biomarkers in glioneuronal tumors

Biomarkers are biological molecules found in blood, other body fluids, or tissues that are a sign of a normal or abnormal process, or of a condition or disease.

BRAF V600E mutation are frequently observed in glioneuronal tumors, particularly gangliogliomas, and this mutation can aid in diagnosis and help distinguish these tumors from other brain *IDH1* and *IDH2* mutations are although more common in gliomas, their presence can also be relevant in certain glioneuronal tumors.

MGMT promoter methylation: This epigenetic modification is associated with better response to alkylating agents in gliomas and can have prognostic value in glioneuronal tumors.

ATRX loss: Often seen in gliomas, ATRX loss can be associated with more aggressive behaviour and poorer prognosis.

Dysregulation of the mTOR pathway is common in several glioneuronal tumors, suggesting that mTOR inhibitors could be effective treatments. TrkB and TrkC are the neurotrophin receptors that are overexpressed in some glioneuronal tumors and can serve as potential targets for therapy.

Therapeutic strategies

Treatment for glioneuronal tumors typically involves a combination of surgery, radiation therapy, and chemotherapy. Advances in understanding the molecular supporting of these tumors are facilitates the more targeted and effective treatments.

Surgical resection: The primary treatment for most glioneuronal tumors is surgical removal. Complete resection is associated with better outcomes, but the location of these tumors often makes complete removal challenging without damaging critical brain structures.

Radiation therapy: Postoperative radiation therapy is used to control residual disease, especially in cases where complete surgical resection is not possible. Stereotactic radiosurgery is a precise form of radiation therapy that targets the tumor while sparing surrounding healthy tissue.

Chemotherapy: Traditional chemotherapy agents, such as temozolomide, are used in the treatment of glioneuronal tumors, particularly those with MGMT promoter methylation. Targeted therapies are being explored based on the specific genetic alterations identified in these tumors. For example, *BRAF* inhibitors for tumors with *BRAF V600E* mutations and mTOR inhibitors for tumors with mTOR pathway activation.

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Emerging therapies: The use of immune checkpoint inhibitors and other immunotherapeutic approaches is an area of active investigation. The unique immune environment of the brain poses both challenges and opportunities for these treatments. Gene therapy techniques that involve modifying the genetic material of cells to fight disease are being explored. This could include using viral vectors to deliver therapeutic genes directly to tumor cells.

Multidisciplinary approach

Managing glioneuronal tumors requires a multidisciplinary team approach involves as mentioned below.

Neurosurgeons: Perform the initial surgical resection and work closely with other specialists to plan and execute treatment strategies.

Neuro-oncologists: Specialize in the medical treatment of brain tumors and coordinate chemotherapy and targeted therapy regimens.

Radiation oncologists: Design and administer radiation therapy plans, ensuring precise targeting of tumor tissue.

Pathologists and molecular biologists: Analyze tumor tissue to identify genetic mutations and molecular markers, providing critical information for personalized treatment plans.

Radiologists: Conduct imaging studies to diagnose, monitor treatment response, and detect tumor recurrence.

Neurologists and rehabilitation specialists: Manage symptoms and provide supportive care to improve patient's quality of life.

Clinical researchers: Conduct clinical trials to test new therapies and improve existing treatment protocols.

Advances in understanding gene expression in human glioneuronal tumors have significantly impacted the identification of biomarkers and the development of targeted therapies. A multidisciplinary approach is essential for effectively managing these complex tumors, ensuring that each patient receives comprehensive and personalized care. Continued research and collaboration across specialties will further enhance our ability to diagnose, treat, and ultimately improve outcomes for patients with glioneuronal tumors.