Circulating tumor DNA

- Cerebrospinal Fluid-Derived Genomic Alterations Tracking Glioma
- Tumor Marker Test in Cerebrospinal Fluid for Leptomeningeal Metastasis Diagnosis and Response Assessment in Non-Small-Cell Lung Cancer
- Furmonertinib in uncommon EGFR-mutated non-small cell lung cancer with central nervous system metastases: A retrospective cohort study
- Liquid Biopsy as a Diagnostic and Monitoring Tool in Glioblastoma
- Consolidative radiotherapy in oligometastatic and oligoprogressive NSCLC: A systematic review
- Extracellular Vesicles Carrying Tenascin-C are Clinical Biomarkers and Improve Tumor-Derived DNA Analysis in Glioblastoma Patients
- DNA methylation profiling from cerebrospinal fluid as a diagnostic tool for pineoblastoma
- Dynamic Tumor in Situ Fluid Circulating Tumor DNA Postsurgery Effectively Predicts Recurrence and Clinical Benefits for Glioblastomas

Circulating Tumor DNA (ctDNA) refers to fragments of DNA released into the bloodstream by cancer cells. These fragments can be derived from primary tumors, metastases, or dying tumor cells. Analyzing ctDNA is a noninvasive approach that can provide valuable insights into the tumor's genetic makeup, progression, and response to treatment.

Key Features of ctDNA

Tumor cells release DNA into the bloodstream through apoptosis, necrosis, or active secretion. Represents a fraction of cell-free DNA (cfDNA), including DNA from healthy cells. Detection Methods:

To detect and quantify ctDNA, techniques such as next-generation sequencing (NGS), PCR-based assays, and digital droplet PCR (ddPCR) are used.

Specific biomarkers or mutations (e.g., KRAS, EGFR, or PIK3CA mutations) can be targeted. Applications:

Diagnosis: Helps in the early detection of cancer.

Monitoring: Tracks tumor dynamics over time, including therapy responses and resistance development.

Prognosis: Provides information on tumor burden and potential metastasis.

Minimal Residual Disease (MRD): Detects small amounts of tumor cells remaining after treatment.

Targeted Therapy Selection: Identifies actionable mutations for precision oncology.

Advantages:

Non-invasive (requires a simple blood draw, often called a “liquid biopsy”).

Real-time monitoring of cancer evolution.

Reduces the need for repeated tissue biopsies. Challenges:

Sensitivity: Detecting low levels of ctDNA in the bloodstream, especially in early-stage cancers, can be difficult. Interpretation: Differentiating ctDNA from cfDNA and understanding its clinical significance. Standardization: Lack of uniform protocols for ctDNA testing across laboratories.

Clinical Implications: ctDNA testing is becoming a cornerstone in personalized medicine, enabling oncologists to tailor treatments based on the molecular profile of tumors. It is particularly useful in cancers such as lung, colorectal, and breast cancer. Ongoing research aims to improve the sensitivity of detection methods and expand the use of ctDNA in routine clinical practice.

Circulating tumor DNA for central nervous system germ cell tumor diagnosis

Circulating tumor DNA for central nervous system germ cell tumor diagnosis.

Primary brain tumors are the most common cause of cancer-related deaths in children and pose difficult questions for the treating physician regarding issues such as the risk/benefit of performing a biopsy, the accuracy of monitoring methods, and the availability of prognostic indicators. It has been recently shown that tumor-specific DNA and proteins can be successfully isolated in liquid biopsies, and it may be possible to exploit this potential as a particularly useful tool for the clinician in addressing these issues.

A review of the current literature was conducted by searching PubMed and Scopus. MeSH terms for the search included “liquid biopsy,” “brain,” “tumor,” and “pediatrics” in all fields. Articles were reviewed to identify the type of brain tumor involved, the method of tumor DNA/protein analysis, and the potential clinical utility. All articles involving primary studies of pediatric brain tumors were included, but reviews were excluded.

The successful isolation of circulating tumor DNA (ctDNA), extracellular vesicles and tumor-specific proteins from liquid biopsies have been consistently demonstrated. This most commonly occurs through CSF analysis, but it has also been successfully demonstrated using plasma and urine samples. Tumor-related gene mutations and alterations in protein expression are identifiable and, in some cases, have been correlated to specific neoplasms. The quantity of ctDNA isolated also appears to have a direct relationship with tumor progression and response to treatment.

The use of liquid biopsies for the diagnosis and monitoring of primary pediatric brain tumors is a foreseeable possibility, as the requisite developmental steps have largely been demonstrated. Increasingly advanced molecular methods are being developed to improve the identification of tumor subtypes and tumor grades, and they may offer a method for monitoring treatment response. These minimally invasive markers will likely be used in the clinical treatment of pediatric brain tumors in the future [1)].

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