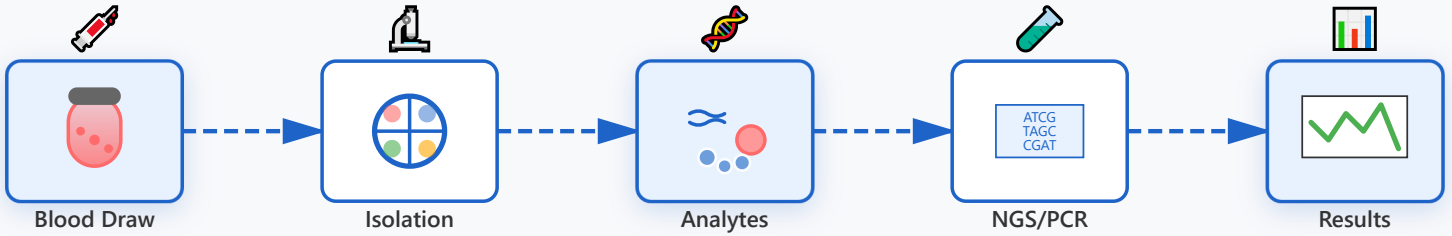
Liquid Biopsy



ctDNA Detection

Circulating tumor DNA analysis from blood samples

CTCs Analysis

Circulating Tumor Cells isolation and characterization

Exosomes

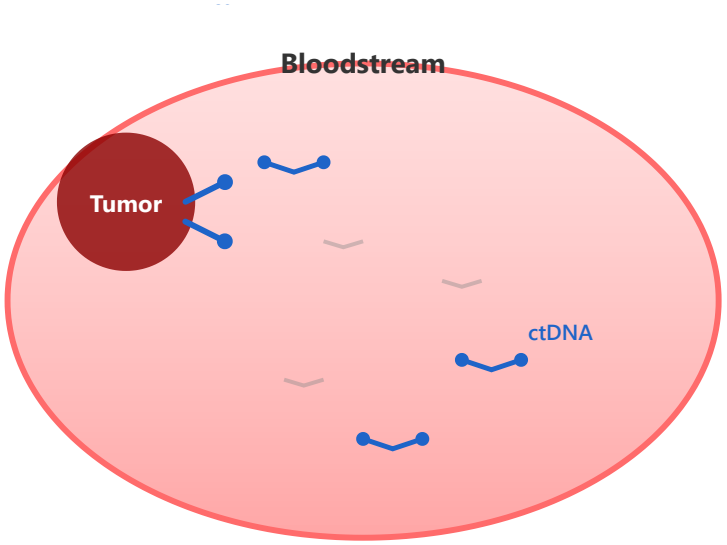
Extracellular vesicles carrying tumor-derived molecules

Early Detection

Non-invasive screening for cancer presence

Monitoring Response: Real-time treatment efficacy assessment through serial sampling

Circulating Tumor DNA (ctDNA) Detection



What is ctDNA?

Circulating tumor DNA (ctDNA) refers to small fragments of DNA released by tumor cells into the bloodstream through apoptosis or necrosis. These fragments carry tumor-specific genetic alterations and can be detected in peripheral blood samples.

Key Characteristics

- Fragment size: typically 150-200 base pairs
- Half-life: approximately 16 minutes to 2.5 hours
- Concentration: 0.01% to 10% of total cell-free DNA
- Detection methods: NGS, digital PCR, BEAMing
- Reflects real-time tumor dynamics

Mutation Detection

Identify specific genetic alterations (SNVs, CNVs, indels)

Treatment Monitoring

Track tumor burden and therapy response

Minimal Residual Disease

Detect residual cancer after treatment

Resistance Mechanisms

Identify emerging resistance mutations

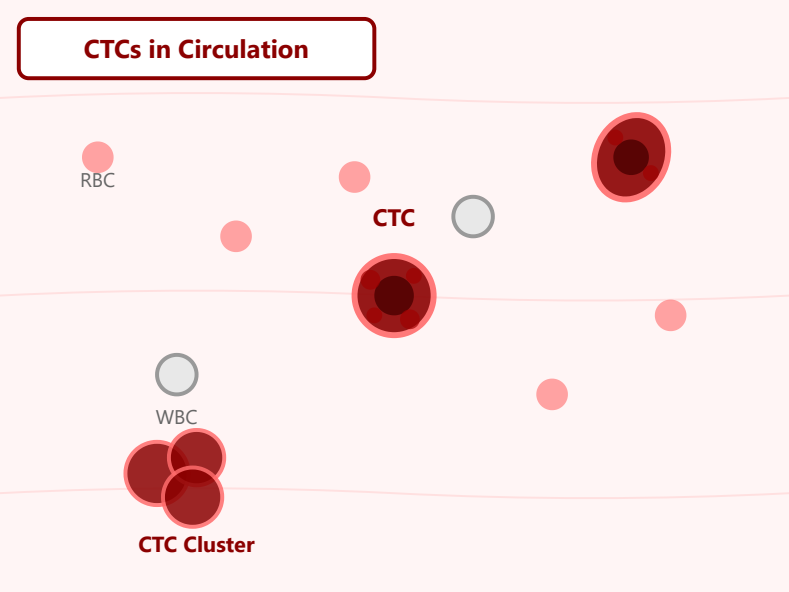
Tumor Heterogeneity

Capture genetic diversity across metastases

Early Relapse

Predict recurrence before clinical symptoms

Circulating Tumor Cells (CTCs) Analysis



What are CTCs?

Circulating Tumor Cells are intact, viable tumor cells that have shed from primary or metastatic tumors into the bloodstream. They represent a critical step in the metastatic cascade and provide unique insights into cancer biology.

Key Features

- Rarity: 1-10 CTCs per 7.5 mL blood (among billions of normal cells)
- Size: 15-25 µm (larger than blood cells)
- Phenotype: Express epithelial markers (e.g., EpCAM, cytokeratins)
- Can exist as single cells or clusters
- Maintain tumor cell characteristics

Enumeration

Count CTCs for prognostic assessment

Molecular Profiling

Analyze RNA, DNA, and protein expression

Ex Vivo Culture

Grow CTCs to test drug sensitivity

Single-Cell Analysis

Study heterogeneity at cellular resolution

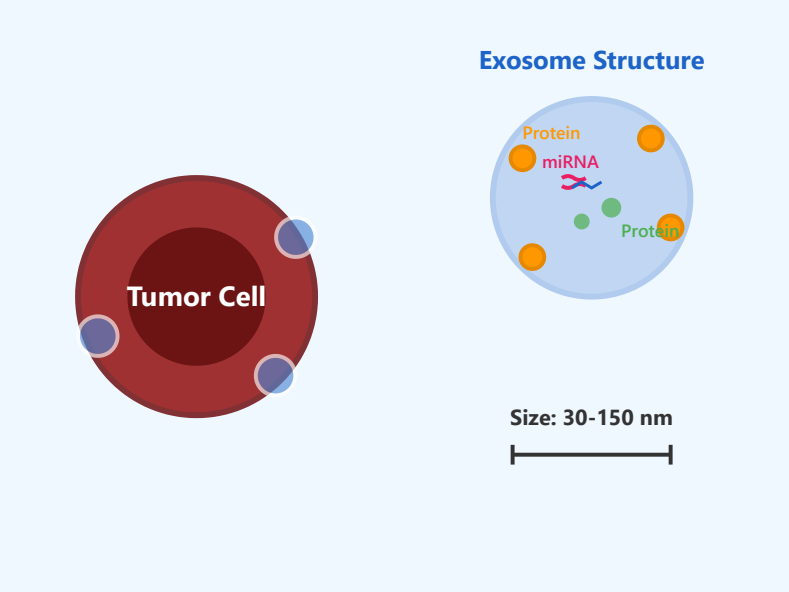
Prognostic Value

Predict survival and disease progression

Metastatic Potential

Assess cells' ability to establish metastases

Exosomes and Extracellular Vesicles



What are Exosomes?

Exosomes are nano-sized extracellular vesicles (30-150 nm) secreted by cells, including tumor cells. They carry diverse molecular cargo including proteins, nucleic acids (mRNA, miRNA, DNA), and lipids that reflect their cell of origin.

Key Characteristics

- Membrane-bound vesicles with lipid bilayer
- Contain: miRNA, mRNA, proteins, DNA fragments
- Surface markers: CD9, CD63, CD81, HSP70
- Highly stable in circulation
- Mediate cell-to-cell communication
- Protected cargo from degradation

miRNA Profiling

Analyze regulatory microRNAs as biomarkers

Stability

Protected cargo ideal for biomarker studies

Communication

Study tumor microenvironment interactions

Tissue Specificity

Drug Delivery

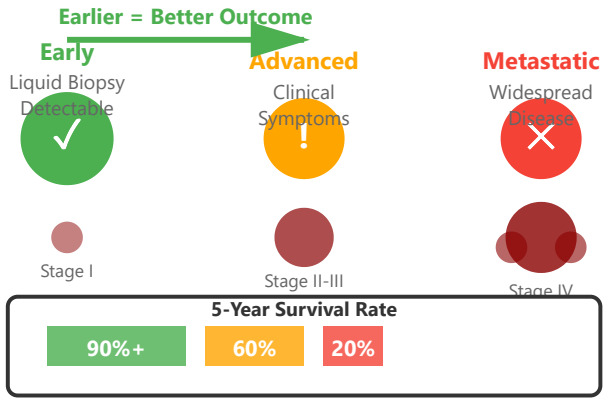
Early Detection

Identify tumor of origin through cargo

Potential therapeutic vehicle

Abundant source for cancer screening

Early Detection and Clinical Applications



Clinical Benefits

Liquid biopsy enables cancer detection at earlier stages when treatment is most effective. The non-invasive nature allows for frequent monitoring, early intervention, and personalized treatment strategies based on real-time molecular changes.

Key Applications

- Screening: Early cancer detection in asymptomatic individuals
- MRD monitoring: Detect minimal residual disease post-treatment
- Treatment selection: Guide targeted therapy choices
- Response monitoring: Assess therapy efficacy in real-time
- Resistance detection: Identify emerging resistance mechanisms
- Recurrence prediction: Early warning of disease relapse

Non-Invasive

Simple blood draw vs. surgical biopsy

Serial Sampling

Monitor changes over time

Comprehensive View

Captures all tumor sites simultaneously

Rapid Results

Patient-Friendly

Cost-Effective

Faster turnaround than tissue biopsy

Reduced discomfort and risk

Lower cost than repeated imaging/biopsies