

Insight into detection of circulating tumor cells today

International GeGe4Nephro Symposium on Sep 16, 2026

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Cancer Statistics in Germany*

* Robert Koch Institute, *Cancer in Germany 2021-2023*

In 2023, approximately **517,800 new cases of malignant tumors** were diagnosed in Germany.

In the same year, approximately **228,960 people died from cancer**.

Most common cancer sites among all new cancer cases in Germany (2023):



Women:

Breast Cancer – 31.3%

Colorectal Cancer – 10.4%

Malignant Melanoma – 5.4%

Men:

Prostate Cancer – 28.8%

Lung Cancer -12.1%

Colorectal Cancer – 10.9%



Cancer should be managed like other chronic diseases, requiring continuous monitoring and an individualized therapeutic approach.

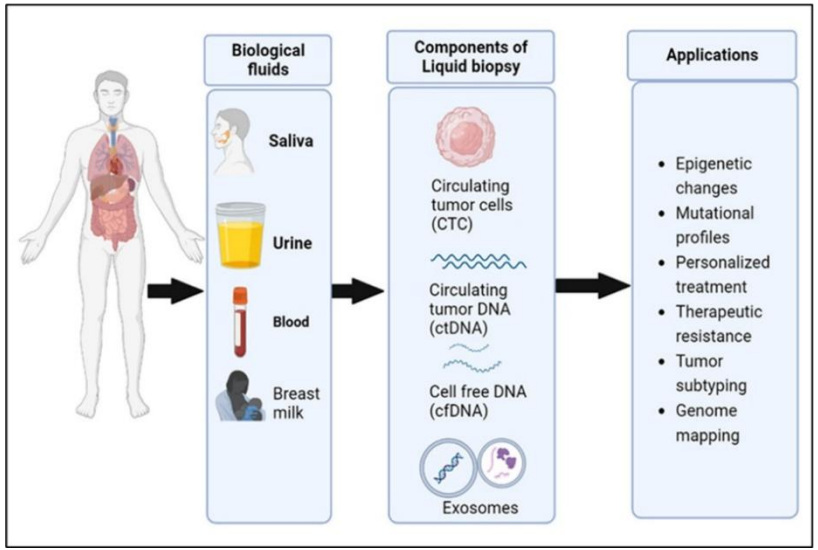
Liquid Biopsy in Oncology

Liquid biopsy is a **minimally invasive diagnostic approach** based on the analysis of body fluids, particularly blood.

Tumors release the following components into the bloodstream:

- **Circulating tumor cells (CETCs/CTCs): intact cells** that have detached from the primary tumor or metastases and entered the bloodstream.
- **Circulating tumor DNA (ctDNA):** DNA released when tumor cells - either within the tumor or after having detached from it - **die**.
- **Exosomes and other tumor-associated components**

➡ Dynamic assessment of tumor activity in real time



Sisodiya S, Kasherwal V, Khan A, Roy B, Goel A, Kumar S, Arif N, Tanwar P, Hussain S. Liquid Biopsies: Emerging role and clinical applications in solid tumours. Transl Oncol. 2023 Sep;35:101716. doi: 10.1016/j.tranon.2023.101716. Epub 2023 Jun 14. PMID: 37327582; PMCID: PMC10285278.

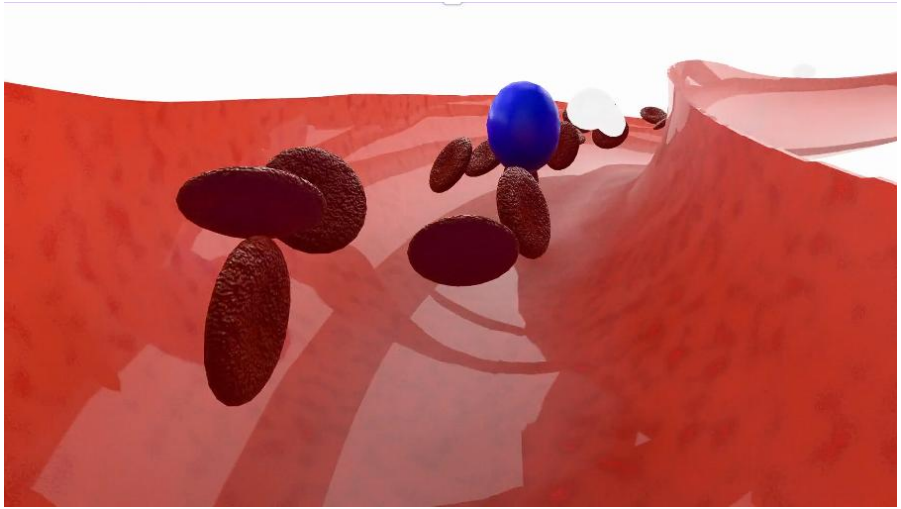
Circulating Tumor Cells

A tumor measuring **1 centimeter** contains approximately **one billion tumor cells**:

1,000 × 1,000 × 1,000 cells measuring 10 µm each.

From a size of **approximately 1 millimeter** onward, a tumor requires a blood supply, through which nutrients enter the tumor, but through which tumor cells can also leave the tumor.

These cells, known as **Circulating epithelial tumor cells (CETCs/CTCs)**, can detach from the primary tumor or metastases, enter the bloodstream and remain there.



3D illustration of a tumor connected to the vascular system, Source: Labor Pachmann/Pachmann GmbH & Co. KG

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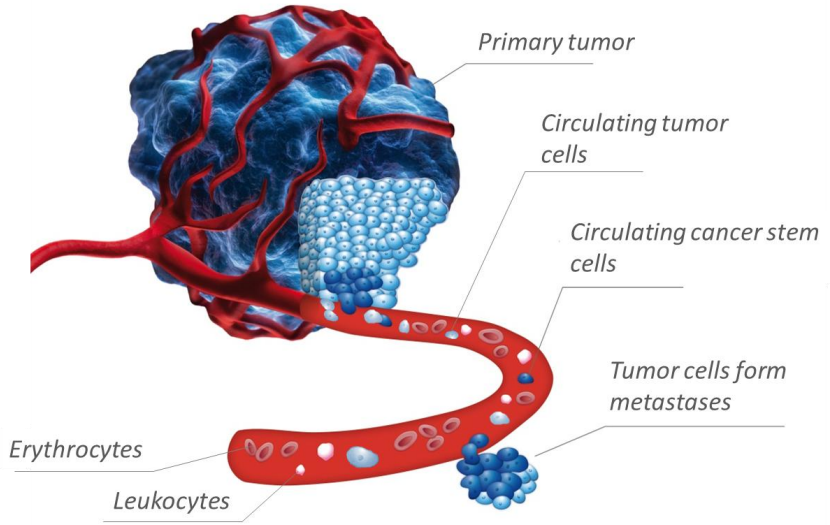
Circulating Tumor Cells



2D illustration of a tumor connected to the vascular system,
Source: Labor Pachmann/Pachmann GmbH & Co. KG

In the bloodstream, circulating tumor cells (CETCs/CTCs) can survive, settle at distant sites - and begin to grow again - leading to the formation of **metastases.**

It is assumed that metastases mainly originate from **circulating cancer stem cells**.

Circulating Cancer Stem Cells

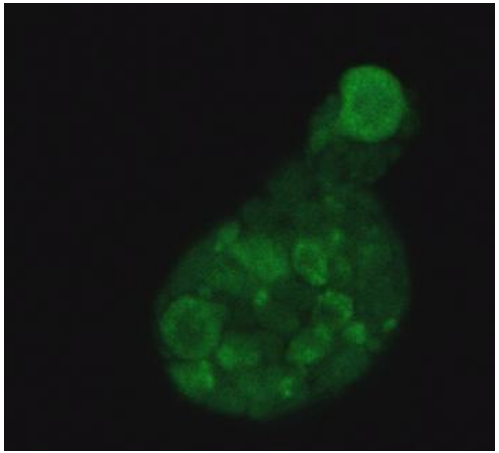
Circulating cancer stem cells (cCSCs) represent a distinct subpopulation of circulating tumor cells and account for approximately 0.1–2.0% of the tumor cell population.

Characteristics:

A subpopulation of tumor cells with stem cell properties, including the ability to self-renew and to differentiate into a heterogeneous population of cancer cells.

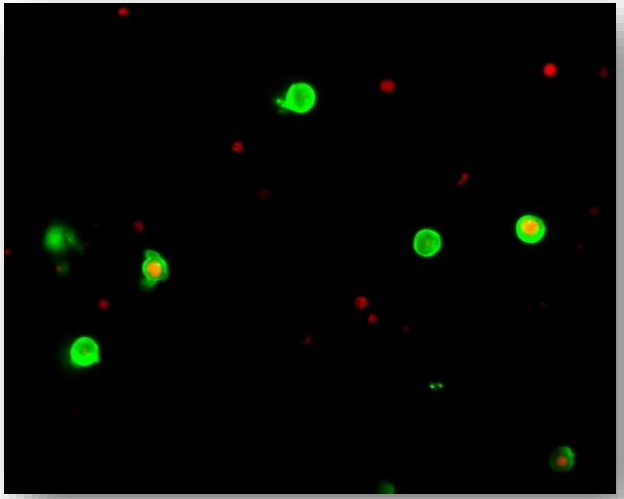
These cells are assumed to be responsible for tumor initiation, progression, recurrence, and metastasis.

More resistant to most therapies.



Microscopic illustration of tumor spheres (stemtrac ®)
Source: Labor Pachmann/Pachmann GmbH & Co. KG

maintrac® Liquid Biopsy



Microscopic image of circulating tumor cells using the EpCAM antigen,
Source: Labor Pachmann/Pachmann GmbH & Co. KG

maintrac® is a minimally invasive method for detecting **viable epithelial tumor cells (CETCs/CTCs)** circulating in the blood before, during and after cancer therapy in patients with a confirmed tumor diagnosis.

- **Direct observation** of the remaining tumor burden
- **Monitoring** of tumor activity
- **Assessment of therapy efficacy and early detection of resistance**, with treatment adjustment if required (maintrac® drug sensitivity testing on tumor cells, maintrac® therapy-relevant tumor cell properties)
- **Early detection of recurrence**

maintrac® Liquid Biopsy

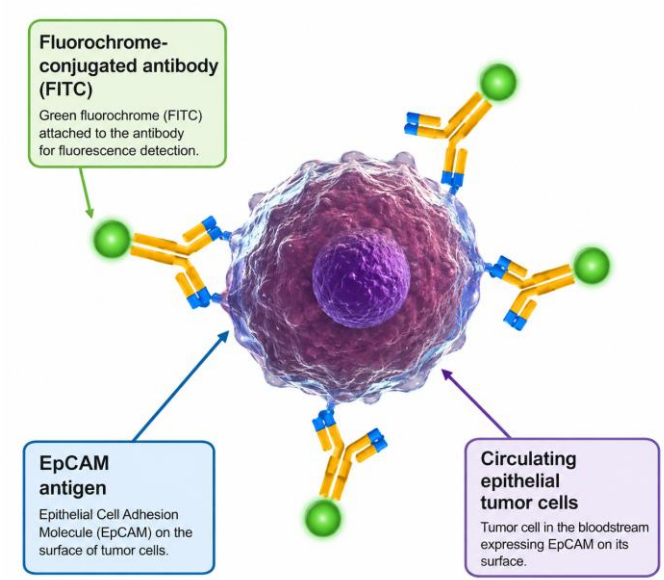


Illustration of the labeling of a tumor cell using the EpCAM antigen,
Source: Labor Pachmann/Pachmann GmbH & Co. KG

Highly sensitive detection of CETCs/CTCs without enrichment steps:

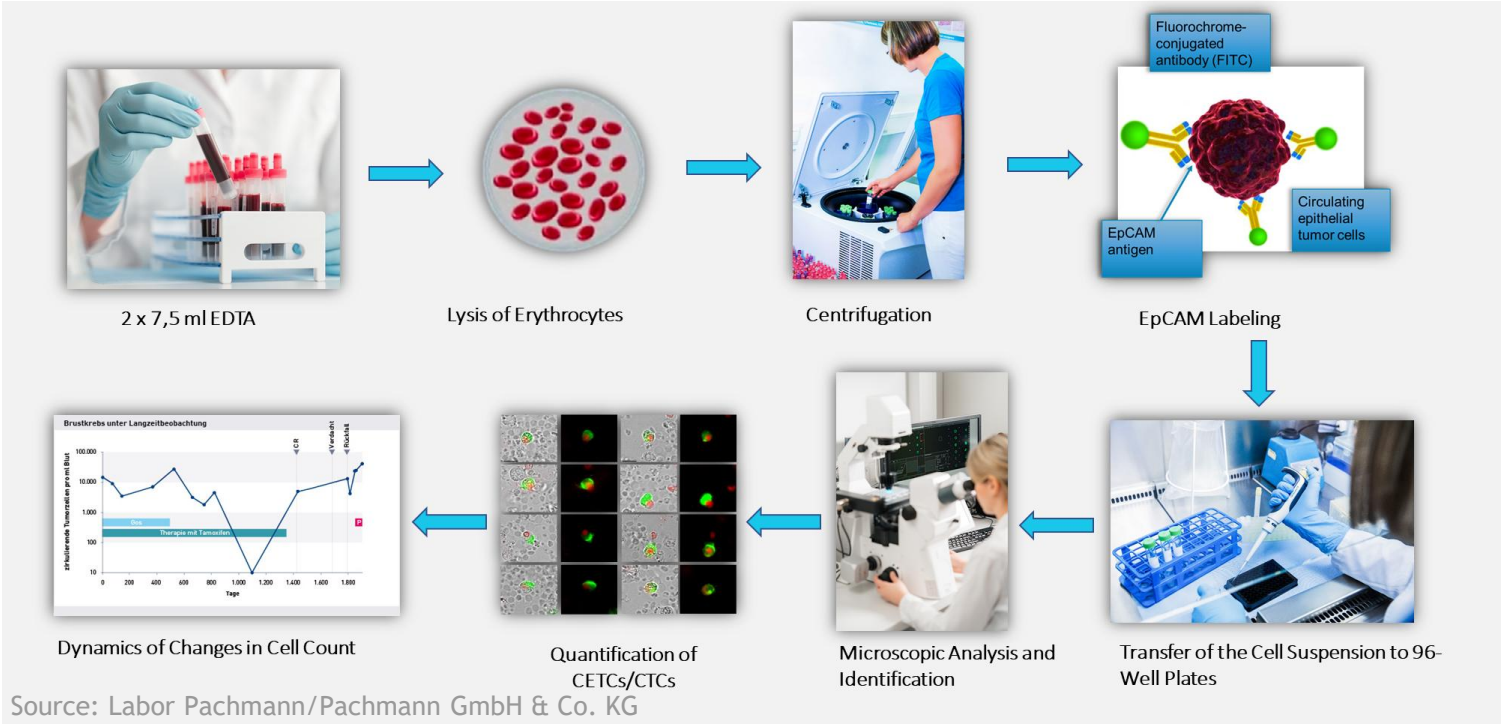
- **No fixation**
- **No isolation**
- **No extraction**

maintrac® can be used for **all solid tumors** whose tumor cells are of epithelial origin.

Its use is limited in sarcomas and gliomas, while malignant diseases of the hematopoietic system (e.g. leukemias and lymphomas) cannot be examined.

Performed in a **laboratory certified** according to **DIN EN ISO 15189.**

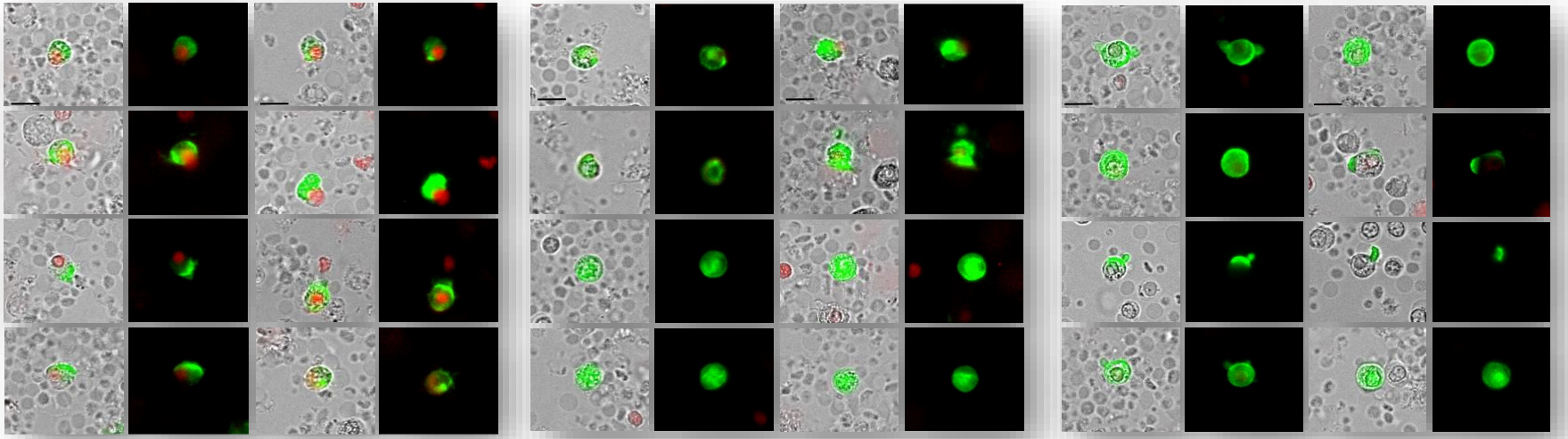
maintrac® Workflow



Source: Labor Pachmann/Pachmann GmbH & Co. KG

maintrac® CETCs/CTCs

Assessment of markers, cell morphology, and viability
Quantity: viable circulating tumor cells
Quality: viable and fragmented tumor cells



Fluorescence microscopic visualization of CETCs/CTCs using an anti-EpCAM antibody
Source: Labor Pachmann/Pachmann GmbH & Co. KG

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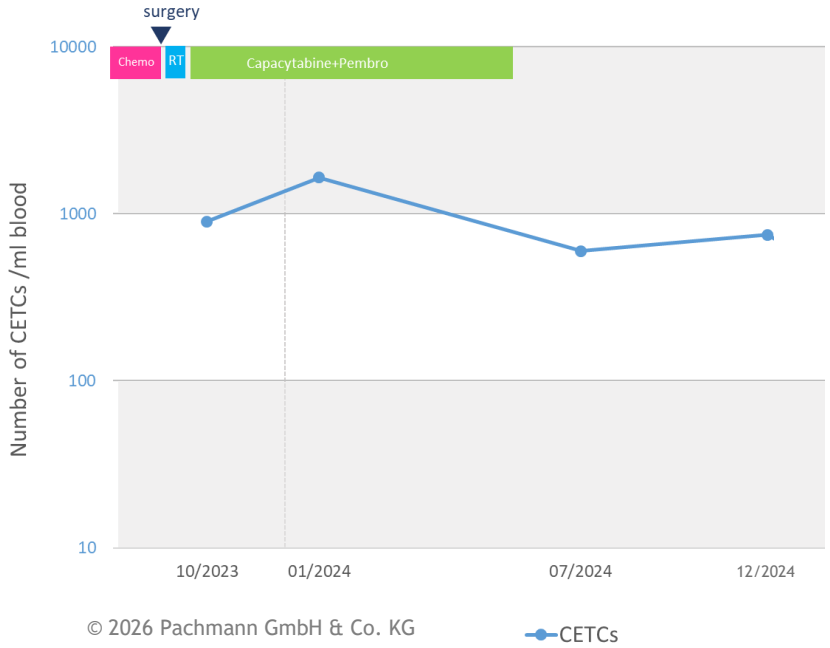
Clinical significance of maintrac®

Before treatment	During treatment	After treatment
Baseline value	**Therapy Monitoring**	**Follow up**
Individual baseline CETC/CTC value as a reference point	Dynamic monitoring of treatment response	Monitoring of minimal residual disease (MRD)
Characterization of circulating tumor cells	Evaluation of treatment efficacy and early detection of disease progression	Early detection of disease recurrence
Therapeutic substance testing for the assessment of treatment efficacy prior to therapy to support treatment-decision making	**In cases of disease progression or suspected treatment resistance:** Therapeutic substance testing, Analysis of therapeutically relevant tumor cell markers, (e.g. PSA, PSMA, ER, PR, HER2/neu, and Ki-67)	
Watch-and-Wait Approach		

Observing directly tumor activity

For optimized and personalized treatment

Case Report 1: Monitoring during & after therapy



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41-year-old patient with triple-negative Breast Cancer, diagnosis: 02/2023

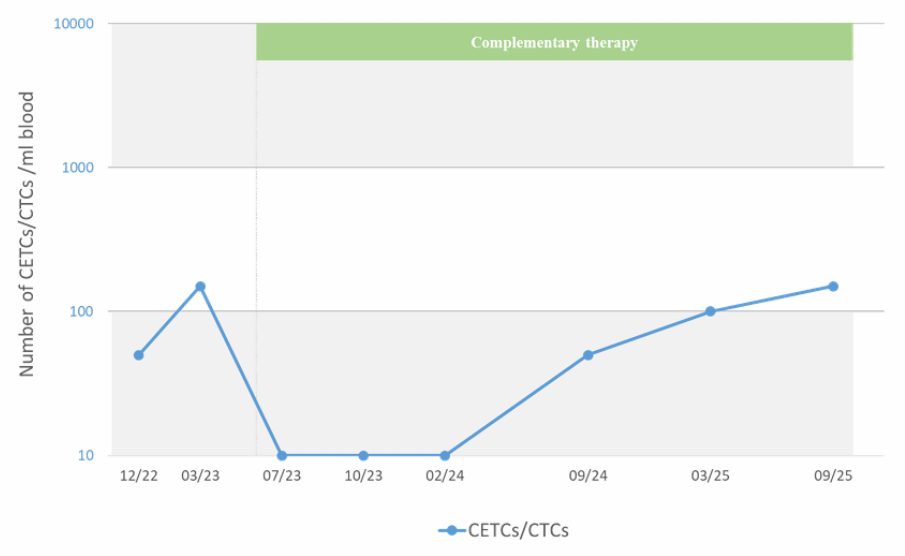
Treatment:

- Neoadjuvant Chemotherapy with Paclitaxel + Pembrolizumab
- Stage: ypT2 ypN0 G3, Ki-67: 90%
- Surgery: 08/2023
- Radiotherapy: 08–09/2023
- Adjuvant chemotherapy with Capecitabine and Pembrolizumab: 10/2023-06/2024

Despite the highly aggressive phenotype (triple-negative, G3, Ki-67: 90%), a pronounced biological response to the combined therapy (chemotherapy + immunotherapy) was observed.

The **dynamic decline of CETCs/CTCs** indicates **therapeutic efficacy**. **Monitoring CETCs** enables **early assessment of the effectiveness** of adjuvant therapy and supports risk stratification for recurrence.

Case Report 2: Watch-and-Wait Approach in Prostate Cancer



62-year-old patient with Prostate Cancer, diagnosis: 12/2022

TNM: cT2a cN0 cMx

Histology: Gleason 3+3

Treatment:

- Watch-and-Wait-Approach

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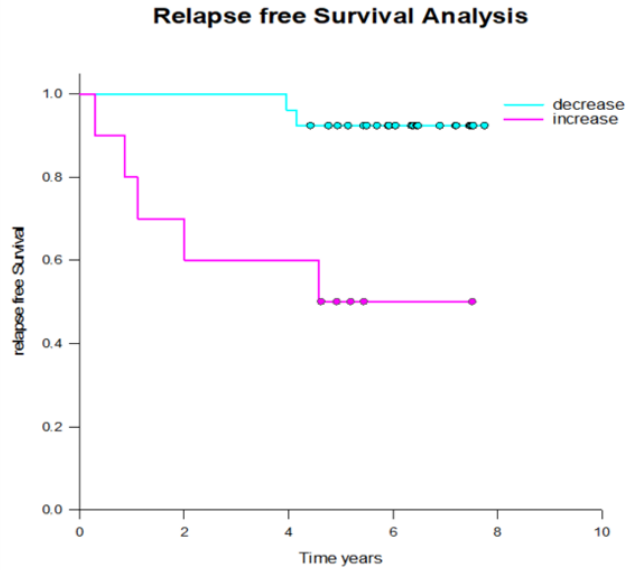
Complementary therapy resulted in the reduction of CETC/CTC counts to a low level.

A **recurrent increase in CETC/CTC** counts during watch-and-wait may signal the need for **therapeutic intervention.**

Study 1: Prostate cancer treated with definitive, adjuvant, or salvage radiotherapy (RT)



Survival Curve in Patients with Prostate Cancer Undergoing Definitive or Adjuvant Radiotherapy,

Source: Schott, D., Pizon, M., Drozdz, S., Mäurer, I., Wurschi, G., Pachmann, K., & Mäurer, M. (2025). Circulating Epithelial Tumor Cells (CETC/CTC) in Prostate Cancer: Potential Prognostic Marker for the Risk of Recurrence During Radiotherapy. *International Journal of Molecular Sciences*, *26*(4), 1548. https://doi.org/10.3390/ijms26041548

Decline During Radiotherapy:

- During radiotherapy, CETC/CTC counts decreased to a low level in most patients, consistent with clinical remission.

Significantly More Events with Increasing CETC/CTC Counts:

- An **increase in CETC/CTC counts during or after radiotherapy** was strongly associated with an **increased risk of recurrence** (HR = 8.8; p = 0.002).
- Note: Patients with a renewed increase in CETC/CTC counts during radiotherapy had an **increased risk of recurrence within the subsequent 2–4 years**.

stemtrac® Tumorspheres



Photo: Labor Pachmann/Pachmann GmbH & Co. KG

stemtrac® is an innovative method for the identification and analysis of circulating cancer stem cells (cCSCs) in the blood.

Circulating cancer stem cells (cCSCs) are believed to play a pivotal role in tumor progression, metastatic dissemination, and therapeutic resistance. These cells are characterized by an increased resistance to treatment modalities.

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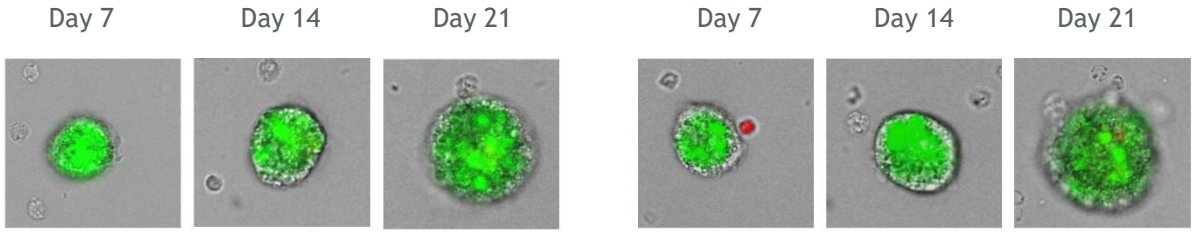
stemtrac® Tumorspheres

- **Assessment of the aggressiveness and metastatic potential** of residual tumor cells after therapy
- Evaluation of an increase in tumor cells to determine whether it is caused by cells with growth potential, especially **while in complete remission**
- In **advanced-stage disease** or when **disease progression** is suspected following loss of EpCAM expression and tumor cell dedifferentiation
- **Long-term follow-up after treatment** for the early detection of tumor recurrence



Fluorescence microscopic visualization of tumor spheres in culture on different days
Source: Labor Pachmann/Pachmann GmbH & Co. KG

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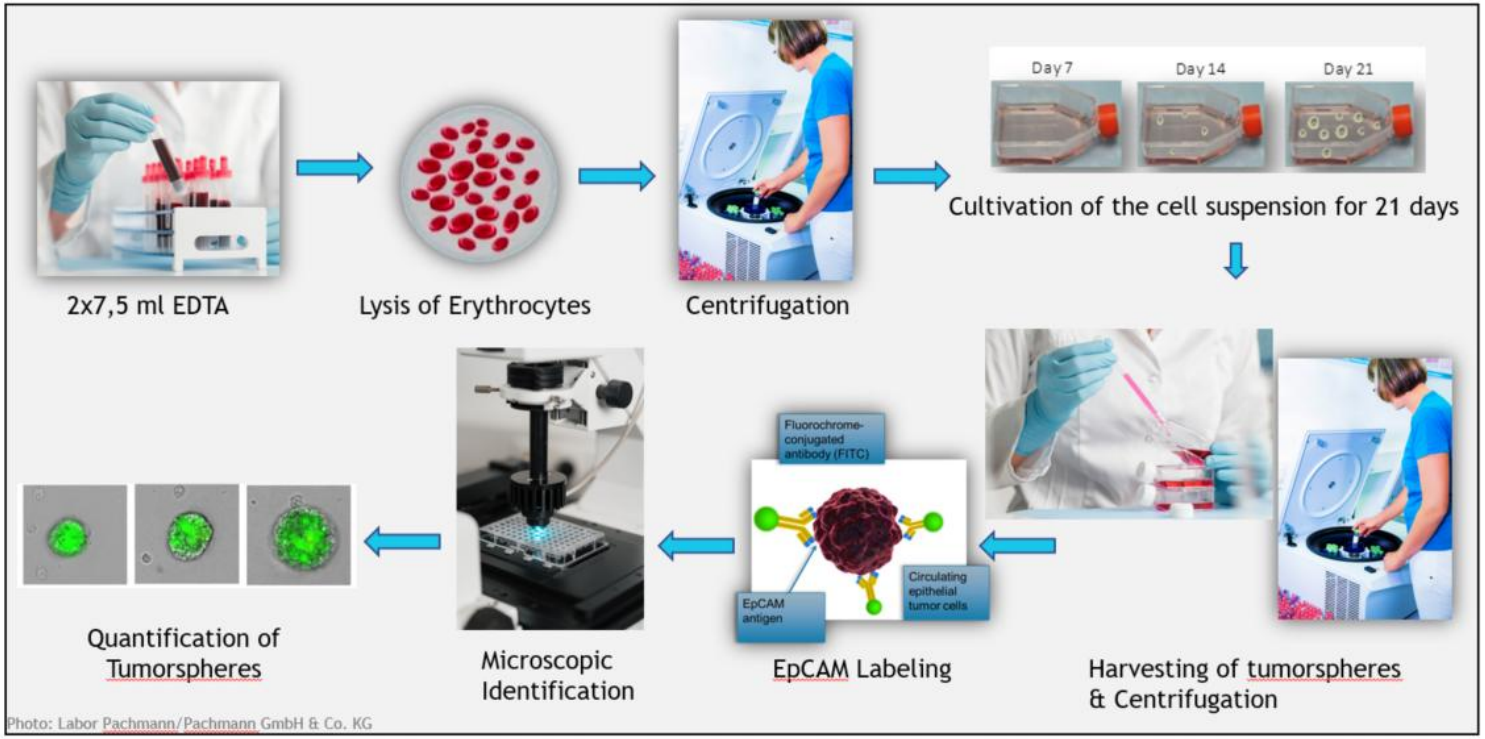
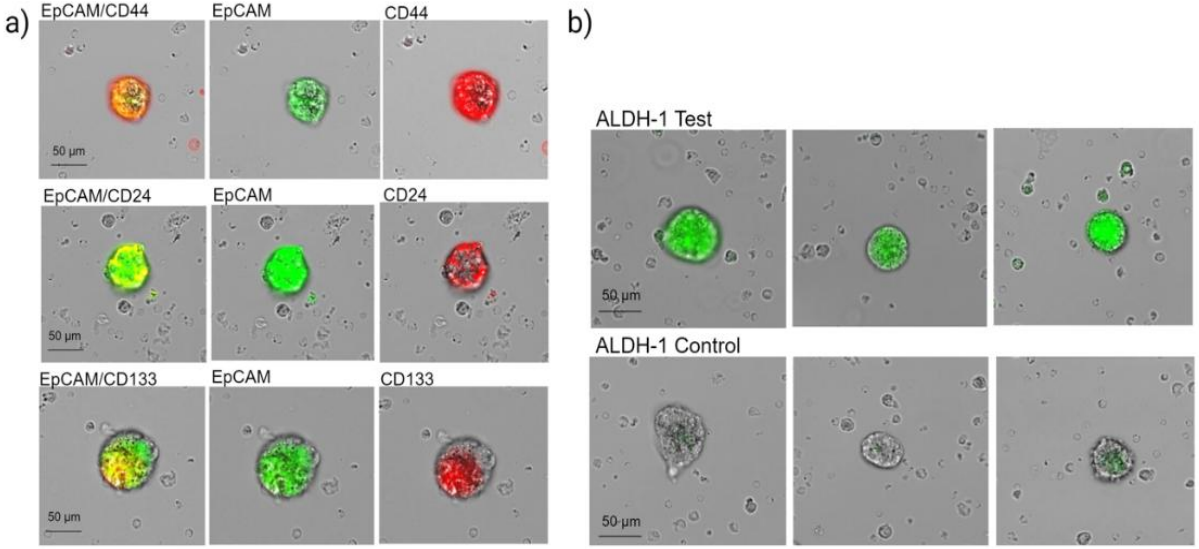
stemtrac® Workflow



In vitro culture under specific conditions enables the growth of **circulating cancer stem cells** over approximately three weeks. Cancer stem cells develop into small, spherical cell aggregates known as **tumorspheres.**

stemtrac® Tumorspheres

Tumorspheres derived from circulating cancer stem cells exhibit **functional stem cell properties** and may additionally display a marker phenotype characteristic of cancer stem cells (e.g., CD44⁺, CD133⁺, CD24⁻/low).



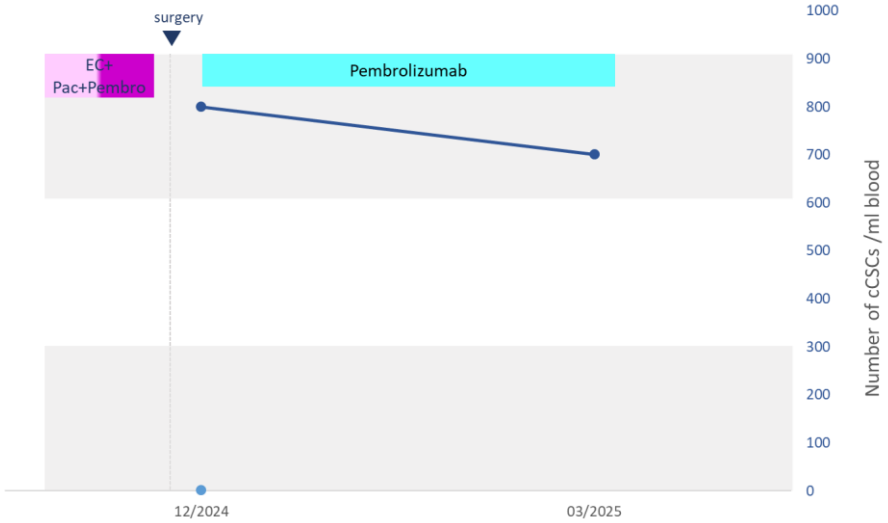
Microscopic visualization of tumorspheres from a patient with pancreatic cancer (stemtrac® tumorspheres)
Source: Labor Pachmann / Pachmann GmbH & Co. KG

Clinical significance of stemtrac® results

Observation in stemtrac®	Biological significance	Clinical conclusion
No / very low number of cCSCs	No active pool of tumor-initiating cells	Low risk of recurrence, good disease control
(Repeated) Decrease in cCSCs during treatment	Therapy eliminated the most aggressive cell population	Effective response to treatment
Persistence of cCSCs despite a decrease in CETCs	Survival of resistant cells	Risk of late recurrence despite "favorable" standard markers
Appearance of cCSCs in Follow up	Reactivation of disease at the biological level	Early signal of recurrence, often preceding imaging findings
Increase in cCSCs with stable / low CETC levels	Selection of stem-like cells	Increasing resistance, risk of progression

Interpretation of the results should take into account the patient's medical history and current clinical status!

Case Report 3: Highly Aggressive Primary Tumor with High Metastatic Risk



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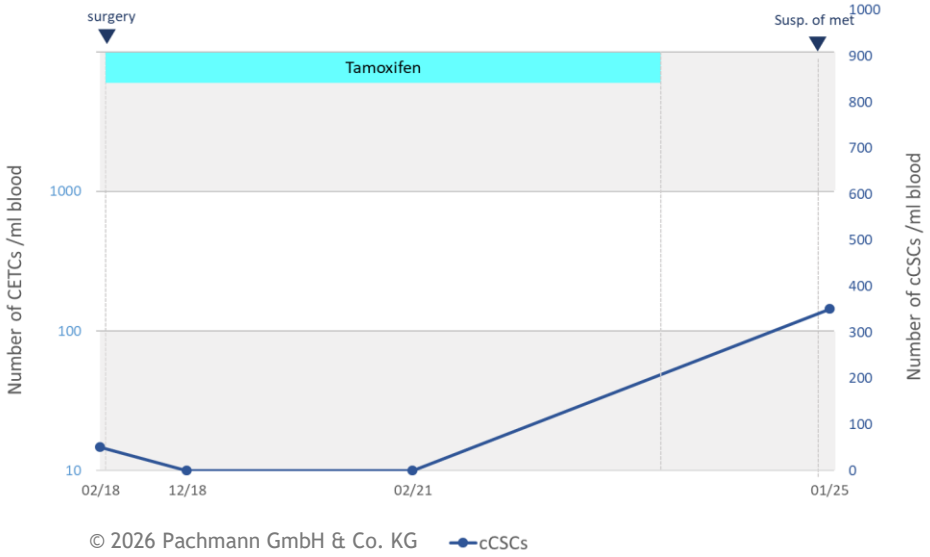
36-year-old patient with triple-negative Breast Cancer, diagnosis: 04/2024

Treatment:

- Neoadjuvant Chemotherapy with EC/Paclitaxel + Pembrolizumab
- Stage: ypT2 ypN0 G3, Ki-67: 90%
- Surgery: 10/2024
- Adjuvant antibody therapy with Pembrolizumab: since 12/2024

Despite ongoing **adjuvant immunotherapy**, tumorsphere counts remain markedly **elevated**, consistent with the **aggressive biology** of the primary tumor and potentially associated with a **high metastatic risk.**

Case Report 4: Breast Cancer with liver metastases



47-year-old patient with Breast Cancer, diagnosis: 01/2016

Histology:

ER+, PR+, Her2/neu: 1+, Ki-67: 25%

Treatment:

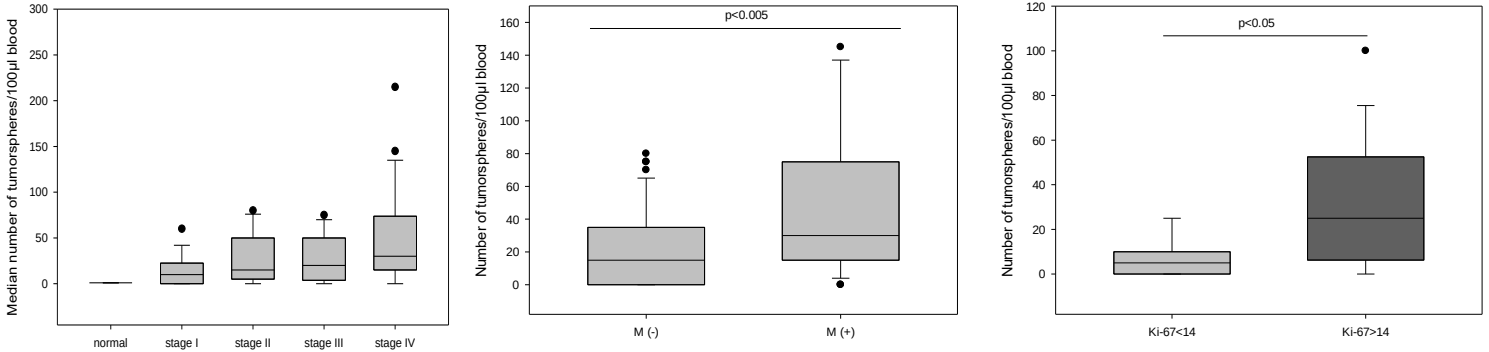
- Surgery: 02/2016
- Local Recurrence: 12/2017
- Surgery: 01/2018

Suspicious lesions in the liver on MRI: 01/2025, Radiological confirmation of hepatic metastases: 02/2025

A decline of tumorspheres was observed during tamoxifen therapy. After completion of the treatment, suspicious lesions were detected on MRI.

stemtrac® revealed an **elevated number of tumorspheres**, correlating with **biopsy-confirmed metastatic lesions.**

Study 2: Tumorspheres Associated with Tumor Stage and Metastatic Disease in Breast Cancer



Source: Pizon M, Schott D, Pachmann U, Pachmann K. The number of tumorspheres cultured from peripheral blood is a predictor for presence of metastasis in patients with breast cancer. Oncotarget. 2016 Jul 26;7(30):48143-48154. doi: 10.18632/oncotarget.10174. PMID: 27340862; PMCID: PMC5217007.

- **Higher numbers of tumorspheres were observed in advanced disease stages** compared with early stages (median: Stage I – 10 vs. Stage IV – 30; $p < 0.002$).
- **Patients with metastatic disease had significantly higher total tumorsphere counts** compared with non-metastatic patients (median: 30 vs. 15; $p < 0.005$).
- Tumorsphere counts were **positively associated with the proliferation index Ki-67 and the histological grade of the primary breast tumors**.

Take-Home Message

The detection of **viable circulating tumor cells** (maintrac®) makes it ideal for disease monitoring and therapy decision-making. It supports the assessment of treatment efficacy and the early detection of disease progression.

The detection of **aggressive and more therapy-resistant cancer stem cell populations** (stemtrac®) supports the assessment of tumor aggressiveness and metastatic risk.

Drug sensitivity testing on circulating tumor cells provides an individualized assessment of the potential effectiveness of therapeutic agents and is particularly valuable before new treatment decisions or when therapy resistance is suspected.

Therapy-relevant tumor cell properties (e.g. ER, PR, HER2/neu, PSA, PSMA) can be determined directly on viable tumor cells and provide important guidance for targeted treatment options.

All methods complement each other and enable precise, personalized therapy planning based on the actual biology of the tumor cells.

Thank you for your attention!

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