

SmartBioSurface® Slides for Prostate Cancer Detection and Risk Stratification through CTC Enumeration and Biomarker Expression Profiling



EUROPEAN
LIQUID BIOPSY
SOCIETY

Francesca Senic-Matuglia¹, Sabrina Picocci¹, Martino Franchi¹, Marzia Luigia De Marni¹, Laurent Gole¹, Daniele Robesti², Leonardo Quarta², Vito Cucchiara², Alberto Briganti², Roberta Carbone¹

1. Tethis S.p.A Via F. Olgiatei 5, 20143 Milan, Italy; 2. Division of Experimental Oncology/Unit of Urology, URI, Urological Research Institute, IRCCS San Raffaele Scientific Institute, Milan, Italy.

Introduction

Prostate cancer (PCa) is one of the **most prevalent cancers in men** and a significant cause of cancer-related deaths [1].

Gold standard procedure for PC diagnosis

- Prostate-Specific Antigen (PSA) testing
- Digital rectal examination
- Tissue biopsy

Limitations and negative aspects

- Low specificity (PSA testing is not a cancer-specific marker)
- Invasive procedure (Side effects of biopsy)
- Limited Accuracy (Undergrading/overgrading cancers)

Our study (NCT04964271) evaluates the use of **SmartBioSurface slides (SBS) for CTC enumeration and characterization [2-4]** in 60 cases (HDs, BPH, LR, csPCa) **to identify clinically significant disease (csPCa) based on CTC detection.**

(Gleason Score ≥ 7 or Gleason Grade group ≥ 2 , according to the European Association of Urology Guidelines) [5].



SmartBioSurface®
slides

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Methods

A complete workflow [4] to identify and characterize CTCs using SBS slides and prostate-specific biomarker staining.

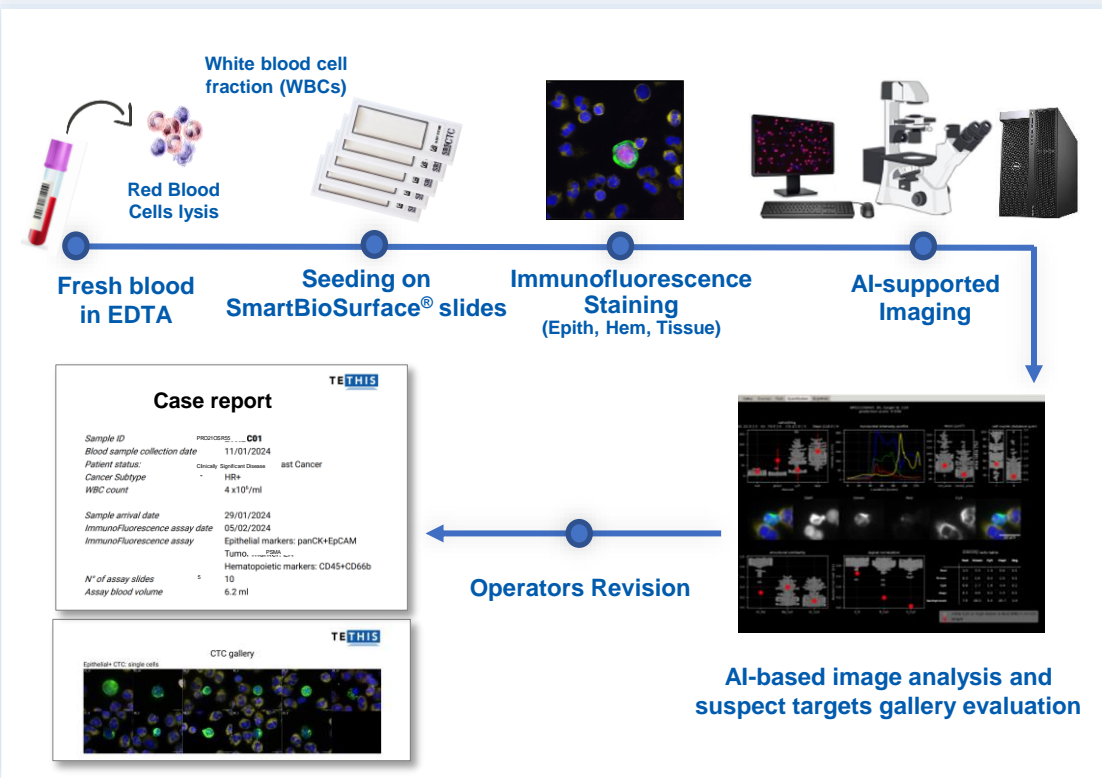


Figure 1. CTCs detection workflow using SBS slides: from blood to Case Report

Single CTCs:

1. Epithelial and prostate-specific markers (PSMA, PSA, or AR) signature
2. Only prostate-specific markers (PSMA, PSA, or AR) signature

CTC clusters:

1. Only Epithelial marker signature
2. Epithelial and prostate-specific markers (PSMA, PSA, or AR) signature
3. Only prostate-specific markers (PSMA, PSA, or AR) signature

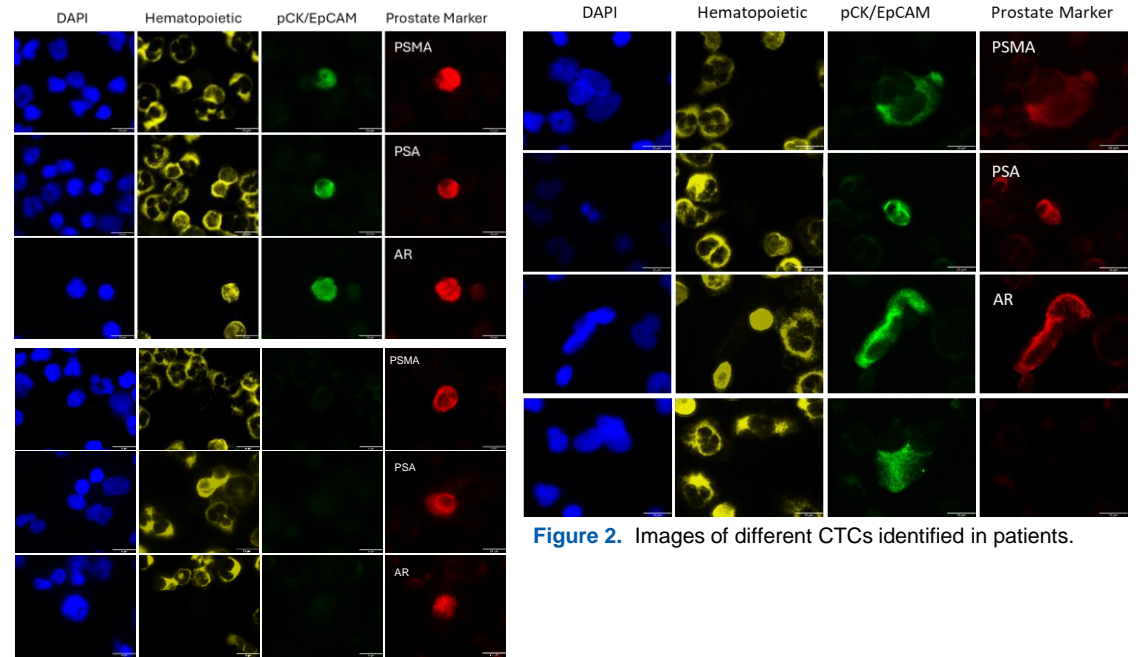


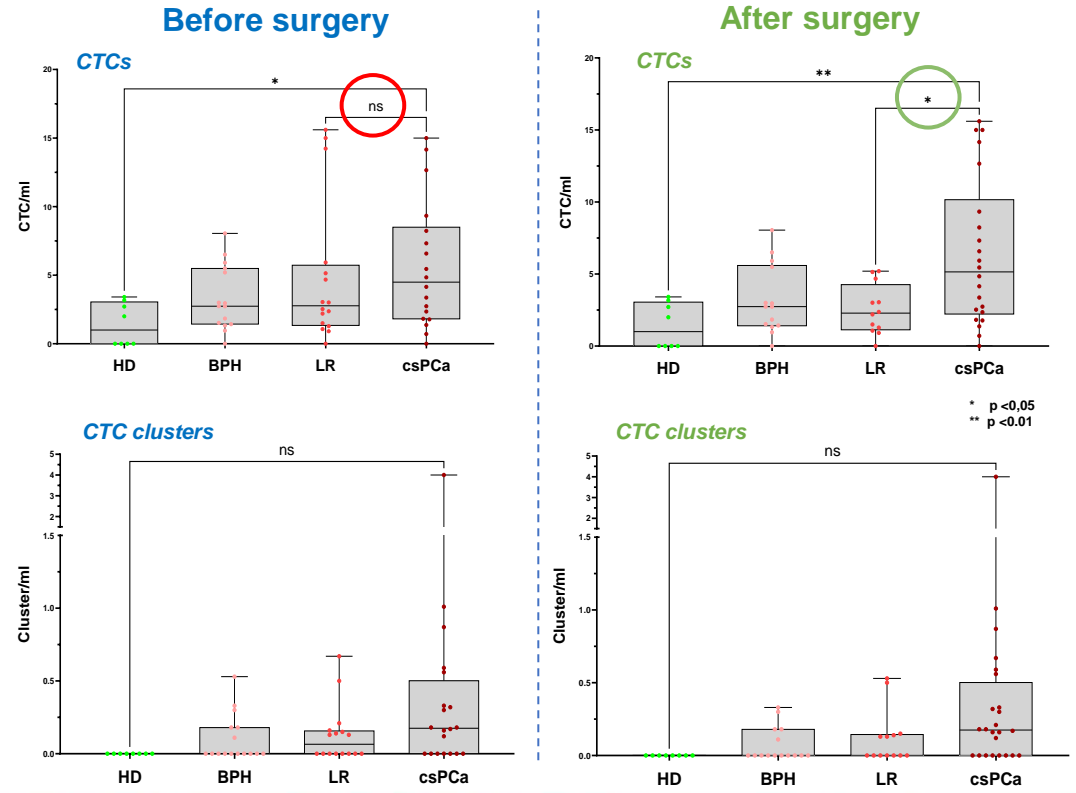
Figure 2. Images of different CTCs identified in patients.



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Results

➤ **Five patients** have been **re-classified after surgery**, providing statistical significance to **CTC enumeration in LR vs csPCa**



Before surgery					After surgery						
	Healthy Donors	BPH	Clinically Significant PCa (csPCa)	Low Risk PCa		Healthy Donors	BPH	Clinically Significant PCa (csPCa)	Low Risk PCa		
N° of patients	8	16	20	16	N° of patients	8	15	24	13		
T Stage					TN Stage			T	N	T	N
					NA			2	2	7	7
T1			7	15	pT1			0	4	1	6
T2			4	1	pT2			5	9	4	0
T3			9	0	pT3			17	9	1	0
ISUP Prostate Biopsy					ISUP Final Pathology						
					NA			2		7	7
ISUP 1			0	15	ISUP 1			1		4	4
ISUP 2-3			3	1	ISUP 2-3			7		2	2
ISUP 4-5			17	0	ISUP 4-5			14		0	0

Number of CTC per ml (mean ± SD)

- 1.41 ± 1.56 CTC/ml in HD
- 3.18 ± 2.39 CTC/ml in BPH patients
- 2.53 ± 1.73 in LR patients
- 6.41 ± 5.11 in csPCa patients

Limitation of the study: no follow-up



Conclusions

SmartBioSurface® slides successfully detect CTCs and CTC clusters in **early prostate cancer patients**.

- **PSMA, PSA, and AR** as **informative** biomarkers for CTC identification;
- A **statistically significant difference** ($p < 0.050$) was observed **between the csPCa and LR groups**, while no significant differences were observed between the LR and the BPH cohort ($p > 0.6$);
- under the most stringent conditions, a **3.41 CTC/ml threshold** distinguished **HD from csPCa, achieving 100% specificity and 59% sensitivity**;
- Potential correlation between **the total number of CTCs and risk classification**, enabling the **stratification** of patients with clinically significant PCa from those with low-risk cancer.

These findings support the potential for **larger clinical studies** to evaluate whether **CTC enumeration and characterization** can provide a more **accurate diagnostic tool** compared to standard methods for detecting tumors and assessing disease severity.

References

- [1] Siegel, R.L.; Miller, K.D.; Jemal, A., 2020, Cancer statistics. *CA Cancer J. Clin.*, 70, 7–30.
- [2] Carbone R. et al., 2006, Biocompatibility of cluster-assembled nanostructured TiO₂ with primary and cancer cells, *Biomaterials*, 27(17):3221-9
- [3] Krol I., Schwab F.D., Carbone R., Ritter M. et al., 2021, Detection of clustered circulating tumour cells in early breast cancer, *Br J Cancer*, 125(1):23-27
- [4] Mastromarino M.G., Parini S. et al., 2023, Liquid Biopsy Detecting Circulating Tumor Cells in Patients with Non-Small Cell Lung Cancer: Preliminary Results of a Pilot Study, *Biomedicines*, 11(1):153
- [5] <https://uroweb.org/guidelines/prostate-cancer>