

Cancer Stem Cells Responsible for Tumour Recurrence

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Why in News?

A new artificial intelligence (AI) framework that identifies 3 distinct developmental states of cancer stem-like cells can help identify hidden cancer stem cells from thousands of patient samples.

- **Cancer stem-like cells** - These are a small and specialised population of cells within tumours.
- They possess stem-cell-like properties, including the ability to self-renew and generate different tumour cell types.
- They can contribute to
 - Tumour recurrence
 - Metastasis
 - Therapy resistance
 - Tumour progression
 - Treatment failure
 - Their rarity and ability to change their cellular identity make them difficult to detect using conventional approaches.
- **ACSCeND** - ACSCeND stands for AI-based Cancer Stem-like Cell Profiler and Neoplasm Deconvoluter.
- It is an AI-based framework designed to identify and quantify different cancer stem-like cell states within tumours.
- **Key Features** - Unlike conventional methods that assign a tumour a single “stemness” score, ACSCeND identifies three distinct CSC developmental states.

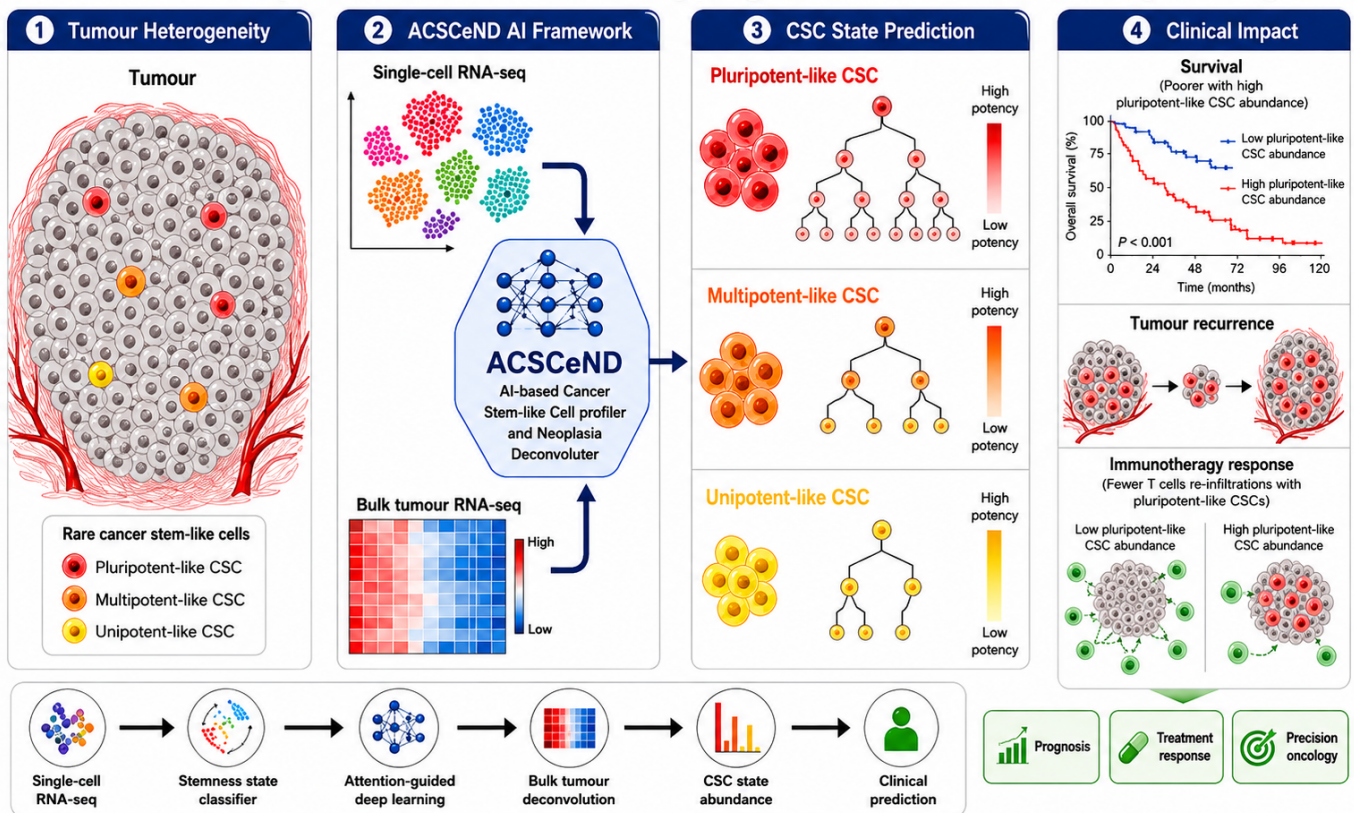
CSC State	Key Feature
Pluripotent-like CSCs	Highest developmental potential
Multipotent-like CSCs	Intermediate developmental potential
Unipotent-like CSCs	More restricted developmental potential

- **Working** - Single-cell RNA sequencing → Stemness-state learning → Deep learning → Bulk tumour RNA sequencing → CSC-state deconvolution → Clinical prediction
- It learns cellular characteristics from high-resolution single-cell RNA sequencing.
- It combines this information with deep learning.
- It can then analyse conventional bulk tumour RNA sequencing data.
- This allows researchers to estimate hidden CSC populations even in large patient datasets where single-cell sequencing is unavailable.
- **Deconvolution** - Deconvolution refers to computationally separating or estimating the different cell populations present within a mixed bulk tumour sample.
- **Role of OncoMark** - OncoMark was an earlier AI platform developed by the researchers.
- It was designed to identify biological hallmarks associated with cancer progression from large

genomic datasets.

- It demonstrated the ability of AI to uncover complex biological patterns that are difficult to detect manually.
- ACSCeND builds upon this AI-based approach to specifically investigate cancer stem-like cells.

AI-powered cross-modal mapping of cancer stem-like cell plasticity



ACSCeND integrates single-cell and bulk transcriptomic data to identify biologically distinct cancer stem-like cell states, enabling large-scale analysis of tumour plasticity, prognosis and therapeutic response across human cancers.

- **Findings of the study** - Researchers applied ACSCeND to more than 25,000 tumour samples from major international cancer databases, including:
 - **TCGA** - The Cancer Genome Atlas
 - **PRECOG**
- The analysis found that tumours with a higher abundance of highly potent, pluripotent-like CSCs were associated with:
 - Poorer patient survival
 - Higher probability of tumour recurrence
 - Reduced response to immunotherapy
- The framework also identified molecular programmes that may help CSCs survive, adapt and evade the immune system.

Reference

[DST | AI uncovers hidden cancer stem cells](#)