IMMUNE CELL THERAPY

Product Development

1. Cell Isolation

Cells are collected from patient (in autologous cell therapies) or donor tissues (in allogeneic therapies).

2. Cell Selection

Cells used for the therapy are selected based on their phenotype.

3. Genetic Modification

Selected cells are genetically modified (e.g., CAR-T/TCR-T) to enhance their anti-cancer properties.

4. Cell Expansion

Once the optimal phenotype is achieved, cells are amplified *in vitro*.

5. Cell Preservation

Cell batches are frozen at very low temperatures to preserve their biological function until their infusion.

AUTOLOGOUS & ALLOGENEIC

Comparison

Due to the underlying illness of the patient, the cells collected may not be of a high quantity or their stability may be affected.	**Cell Yield & Quality**	To allow the collection of a large quantity of fit-for-purpose cells, donors are screened to confirm they are healthy and do not have underlying conditions.
As each product batch is substantially different, this makes it difficult to ensure consistency in the attributes of cells.	**Cell Heterogeneity**	As numerous identical batches of cells originate from the same donor, this ensures greater product consistency.
Administered patient cells are more likely to expand in vivo since there is a lower risk of immunological rejection.	**In Vivo Cell Expansion**	Immunological rejection of administered cells can occur; this limits the in vivo expansion and persistence of cells in the patient.
Due to substantial differences in product batches, it is difficult to optimize and standardize them into industrialized products.	**Product Industrialization**	As higher quantities of cells are collected, there is an opportunity to optimize and standardize the cells for industrialization.
As these therapies are developed according to demand, they require more time (for cell engineering) to be delivered to the patient.	**Time to Delivery**	As these therapies are developed for off-the-shelf administration, they can be rapidly delivered to the patient.
These cells are collected and re-infused back into the same patient; therefore, the risk of immunological elimination and GvHD is lower.	**Immunological Reaction Risk**	As these cells are collected from healthy donors and re-infused into different patients, this can trigger immunological reactions such as GvHD.

CHALLENGES

Finding Solutions with Data

	LIMITED EFFICACY	ADVERSE EFFECTS	RESTRICTED USE IN SOLID TUMORS
Patient Clinical & Molecular Data	Predict the presence of dysfunctional T cells.	Anticipate patient immune response to prevent/alleviate immune-activation related events (CRS/CRES/HLH/MAS).	Identify systemic factors limiting cell trafficking and tumor infiltration.
Tumor Molecular Data	Monitor tumor antigen expression over time to avoid antigen escape-related events.	Identify tumor-specific antigens and verify their expression to prevent on-target/off-tumor toxicity.	Understand the hostility of the tumor environment to identify factors limiting tumor infiltration and cell trafficking.
Immunoprofiling Data	Understand the functionality of the patient's immune system to ensure its reactive response.	Anticipate patient immune response to prevent/alleviate immune-activation-related events (CRS/CRES/HLH/MAS).	Maximize patients' therapeutic benefits by immunoprofiling solid tumors to identify appropriate combination therapy.
Cell Phenotypic & Functional Assay Data	Predict cells' capacity to persist and expand in vivo. Identify sub-optimal cell populations.	Ensure cell therapies are free of contamination through efficient and accurate quality assurance assay data analysis.	Understand cell migratory properties to increase cell trafficking and tumor infiltration.

Outlined in the columns are the challenges of immune cell therapies (limited efficacy, adverse effects, and limited use in solid tumors). The diagram shows how the integration of different types of experimental data (patient/clinical, tumor, immunoprofiling, phenotypic, and functional assay data), can improve efficacy, safety, and targeted application of diverse cell therapies.