Macrophages Polarization
Plasticity in Health and Disease

Generaton of Macrophages in Vitro

Background
Macrophages are tissue-resident professional phagocytes and antigen-presenting cells (APCs), that play a major role in host defense and maintenance of homeostasis by carrying out phagocytosis of dead cell fragments and dead cell products of necrotic cells. Macrophages influence the outcome of various diseases, including allergy, autoimmunity, and cancer [1]. They enforce the functional heterogeneity of M2 macrophages and produce large amounts of inflammatory mediators, such as IL-4, IL-13, and IL-10, which is essential for remodeling tissue and creating an environment that favors tumor growth and spread [2]. Due to this functional heterogeneity of M2 macrophages, their phenotypes and functions are highly variable, potentially even reversing the initial phenotype. Human macrophages influence the outcome of various diseases, including allergy, autoimmunity, and cancer [1]. Therefore, it is important to study the role of macrophages in disease.

M1-activated status under certain conditions.

Macrophages in disease
Macrophages are present in almost all tissues and play a crucial role in antigen-processing and cytokine production. They are involved in the regulation of various processes such as tissue repair and inflammation. Macrophages have a functional diversity that includes tissue repair, tissue remodeling, and the modulation of immune responses. Macrophages can be activated by different stimuli, including cytokines and growth factors, which can lead to the formation of different macrophage subtypes. Macrophages in disease.

Table 1. Human macrophage activation reference table according to the common framework consensus nomenclature [3]. The published table is a draft table of the consensus nomenclature and may be updated in a future version. The human macrophage activation reference table is a guide to different macrophage activation states and their designations.

<table>
<thead>
<tr>
<th>Activation state</th>
<th>Tumor microenvironment</th>
<th>Differentiation factors used to generate macrophages (GM-CSF = granulocyte/macrophage colony stimulating factor)</th>
<th>Activated (day 7)</th>
<th>Activated process reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1-activated</td>
<td>M(IFN-γ)</td>
<td>GM-CSF or M-CSF + IFN-γ</td>
<td>TNFα and LPS (1 ng/ml) + IFN-γ</td>
<td>[11]</td>
</tr>
<tr>
<td>M2-activated</td>
<td>M(IFN-γ)</td>
<td>GM-CSF or M-CSF + IFN-γ</td>
<td>TNFα and LPS (1 ng/ml) + IFN-γ</td>
<td>[11]</td>
</tr>
<tr>
<td>M1-activated</td>
<td>M(-) M1 GM-CSF</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M2-activated</td>
<td>M(-) M1 GM-CSF</td>
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<td>-</td>
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<td>[11]</td>
</tr>
<tr>
<td>M1-activated</td>
<td>M(-) M1 GM-CSF</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M2-activated</td>
<td>M(-) M1 GM-CSF</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TAM</td>
<td>M(-) M1 GM-CSF</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

New nomenclature
Realization has therefore recently spread that the traditional M1/M2 model does not fully reflect the whole complexity of activation states of the highly plastic cell lineage [4]. In contrast, an international consensus group of macrophage experts has published a joint framework proposal for macrophage activation nomenclature for distinction into two macrophage activation states according to the transcriptional program of the macrophage and the different factors used to generate the macrophage (Table 1) [5].

Defining the macrophage culture system, in conjunction with the published reference table and the functional properties of macrophage activation, is essential for making meaningful comparisons of macrophage phenotypes.

References

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Vascular endothelial
growth factors

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Involvement of Macrophages in Health and Disease
Macrophages are involved in numerous chronic inflammatory and autoimmune diseases such as rheumatoid arthritis, asthma, and multiple sclerosis. They also play a role in the development of tumors and cancer. Macrophages are also involved in the pathogenesis of various chronic diseases, including atherosclerosis, fibrosis, inflammatory bowel disease, and diabetes. Macrophages are also involved in the pathogenesis of various chronic diseases, including atherosclerosis, fibrosis, inflammatory bowel disease, and diabetes.

Perspectives
The issues regarding to the role of macrophages in disease are rapidly expanding, and the impact on research is increasing. The determination of the functional properties of specific macrophage subsets may give rise to a travel classification system for macrophages based on their origins and functional phenotypes. This will help to identify the wide variety of macrophages that has long been neglected. The use of different macrophage subtypes for the treatment of diseases is becoming increasingly important.

Macrophage plasticity and polarization
Macrophage plasticity and polarization are central concepts in the field of immunology. Macrophage plasticity refers to the ability of macrophages to switch between different phenotypes in response to different microenvironments. This can be expected to generate insights into the wide variety of pathologies.

Figure 1: Macrophage plasticity and polarization in different types of pathologies. Macrophages exhibit high plasticity and can switch between polarized states in response to different microenvironments.

Figure 2: Macrophage plasticity and polarization in different types of pathologies. Macrophages exhibit high plasticity and can switch between polarized states in response to different microenvironments.

The tumor then creates an immunosuppressive environment, whereas M2-like macrophages are more commonly associated with chronic inflammatory processes.

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