First ever 'atlas' of T cells in human body

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By analyzing tissues harvested from organ donors, Columbia University Medical Center (CUMC) researchers have created the first ever "atlas" of immune cells in the human body. Their results provide a unique view of the distribution and function of T lymphocytes in healthy individuals. In addition, the findings represent a major step toward development of new strategies for creating vaccines and immunotherapies. The study was published today in the online edition of the journal *Immunity*.

T cells, a type of white blood cell, play a major role in cell-mediated immunity, in which the immune system produces various types of cells to defend the body against pathogens, cancer cells, and foreign substances.

"We found that T cells are highly compartmentalized—that is, each tissue we examined had its own complement of T cells," said study leader Donna L. Farber, PhD, professor of surgical sciences at CUMC and a principal investigator with the new Columbia Center for Translational Immunology (CCTI), directed by Megan Sykes, MD. "The results were remarkably similar in all donors, even though these people were very different in terms of age, background, and lifestyle."

The researchers also discovered a receptor that is expressed on the surface of "tissue-resident" T cells but not on circulating T cells. Using this marker, Dr. Farber and her colleagues established that the blood is its own compartment. "In other words, T cells found in circulation are not the same as T cells in the tissues," said Dr. Farber.

According to the researchers, the findings establish a baseline for T-cell immunity in healthy individuals. This knowledge can be used to better understand how various tissues respond to site-specific and systemic autoimmune and inflammatory diseases. The findings can therefore powerfully inform the development of new vaccine strategies. "To make better vaccines, it may be necessary to activate a T-cell response at the site of an infection, not just in the general circulation," said Dr. Farber. "But first we have to know what types of immune cells are in those tissues and how they function. This is a first step in that direction."

To study T cells, researchers need multiple tissue samples, which cannot be taken from healthy individuals. Working with the New York Organ Donor Network, the organ procurement organization for the greater New York metropolitan area, CUMC researchers obtained tissue samples from 24 individual organ donors. Samples were taken from tissues that have direct contact with pathogens, including lymph, lung, spleen, and small and large intestines. The donors, all of whom had died suddenly of traumatic causes, ranged in age from 15 to 60. All were HIV-negative and free of cancer and other chronic or immunological diseases.

"Most of what we have known about human T cells is based on studies of the blood, because it is so accessible," said Dr. Farber. "But that is only a small sampling of the body's T cells. We already had good evidence, from mouse studies, that other tissues have their own types of T cells and that they play an important role in mediating immune protection. We wanted to find out if this was the case in humans."

More information: The title of the paper is "Distribution and compartmentalization of human circulating and tissue-resident memory T cell subsets."