INNOVATION ENGINES AT NORTHWESTERN MEDICINE
INFLAMMATION AUTOIMMUNITY IMMUNOLOGY
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INFLAMMATION/AUTOIMMUNITY/IMMUNOLOGY

At Northwestern Medicine, our technologic drivers of innovation—known as the Innovation Engines—interact in a cross-cutting manner with our disease-focused institutes to create a matrix organization. One of our leading innovation engines is the study of the immunologic and inflammatory events underlying a number of diseases including arteriosclerosis, allergy, autoimmune disease, infection, and cancer.

Inflammation is derived from Latin, stemming from inflammationem, literally “setting on fire.” This is a fitting description of the experience of many patients with inflammatory and autoimmune diseases. We now know that there is a balance between protective immunity and damage inflicted by the immune and inflammatory response. Cells and molecular mechanisms underlying our resistance to infectious agents also are involved in the body’s recognition and response to foreign substances. These protective mechanisms can turn against one’s self causing tissue injury and disease.

At Northwestern, our scientists and clinicians are working together to study immunologic and inflammatory events and how they cause disease. Through their collaborations and dedicated efforts, we have the opportunity to develop new knowledge and new therapeutics to help people with allergies, autoimmune diseases, cancer, and organ transplants.

Infectious Diseases
To survive, humans must protect themselves from disease-causing microorganisms as diverse as bacteria, viruses, fungi, and parasites. A variety of cell types and soluble molecules is involved in recognizing and destroying the causative agents for tuberculosis, malaria, HIV, and other major scourges of mankind. Variations in DNA sequence may have a significant impact on how each of us responds to these pathogens. Studying the target cells as well as the immune cells and antibody molecules that are ever vigilant to protect us from infections, should provide new avenues for treating infectious disease as well as approaches to non-infectious diseases caused by or affected by immune mechanisms. An important area is the development of vaccines that, in addition to applications for infectious diseases, now offers potential approaches to allergy, cancer, and autoimmune diseases.

Transplantation
Transplantation involves the transfer of cells or organs from one individual to another in order to replace a failed organ or tissue. Unfortunately, immune cells often reject grafts when they recognize the foreign cells as “non-self.” A variety of agents have been developed to block graft rejection. So-called immunosuppressive drugs have made organ and stem cell transplantation realities, but infections and other complications remain. The “holy grail” of immunotherapy is “immune tolerance,” the state of immunologic non-responsiveness to an antigen. Thus, just as we normally do not attack our own cells and organs, the immune system can be taught not to respond to transplanted cells. At Northwestern, we are actively investigating mechanisms of immune tolerance to develop cures for transplant rejection. These studies will likely also provide new approaches to cancer and autoimmune diseases.

“Cells involved in immunity are essentially the same as those in transplantation, autoimmunity, and cancer. In transplantation and autoimmunity, effector cells are bad and regulatory cells are good; whereas in cancer, effector cells are good and regulatory cells are bad. In understanding the basic mechanisms through which these cells are activated and by which they exert their effects, we can help advance transplantation, autoimmunity, and cancer all at the same time.”

Stephen Miller, PhD, Judy Gugenheim Research Professor of Microbiology-Immunology, Northwestern University Feinberg School of Medicine
Autoimmune Diseases

Autoimmune diseases are the result of the immune system turning against one’s own cells and organs, causing disease. Type I or childhood diabetes is caused by immune cells attacking the pancreas, knocking out insulin production, and leading to high blood sugar and inflammatory disease in the kidney, eyes, and blood vessels throughout the body. Immune cells can attack nervous system/brain tissue in multiple sclerosis or neuropathies; the heart in myocarditis, or vasculopathies; the lung in scleroderma, the kidney in systemic lupus erythematos, glomerulonephritis or nephrotic syndrome; the gastrointestinal system in inflammatory bowel diseases; joints in rheumatoid and other forms of arthritis; blood cells in hemolytic anemia; skin in psoriasis, scleroderma, or dermatomyositis; and a myriad of other disorders. At Northwestern, researchers are studying the reasons why the immune system turns against the host and how such autoimmunity can be prevented.

Allergy

Allergies are unfortunately on the rise in modern, developed nations and are another example of diseases caused by the immune system. Cells, as well as antibodies and other molecules, interact to develop strong and inappropriate reactions to environmental substances or foods leading to diseases such as hay fever, asthma, chronic skin conditions (eczema), or food allergies, which can damage organs. Advances in understanding the cells, molecules, and mechanisms involved are leading to new therapeutic approaches for these debilitating and sometimes life-threatening diseases.

Cancer

Cancer is the result of uncontrolled growth of a particular cell type. The immune system is now known to be important in recognizing and destroying cancer cells. Cancer cells are believed to arise in the body regularly as a result of exposure to environmental factors including chemicals, strong sunlight, radiation, and other causes, but they are suppressed by the immune system. New cell therapies, vaccines, and drugs based upon our understanding of the immune system are providing new hope for patients with cancer. Some new treatments train the immune system to specifically recognize a cancer that has arisen in a patient, while others take the brake off the immune system and amplify the protective responses that are usually there but have failed.

Atherosclerosis

Atherosclerosis, the major cause of coronary artery disease, is an inflammatory disease. The risk of atherosclerosis is increased in patients with autoimmune diseases such as systemic lupus erythematosus and rheumatoid arthritis. The lesions are filled with immune cells that orchestrate and effect inflammation. Understanding the role of these cells in atherosclerosis may impact the therapy of heart disease and stroke. Understanding how to prevent excessive entry of inflammatory cells into sites of inflammation may lead to therapies for chronic inflammatory/immune diseases such as atherosclerosis, inflammatory bowel disease, and multiple sclerosis.

Inborn Errors of Metabolism and Congenital Diseases

Inborn errors of metabolism and congenital diseases are due to the failure of a particular cell type or molecule to function due to mutations. Common diseases like sickle cell disease and cystic fibrosis are due to such mutations, but most congenital immunodeficiencies are rare. Bone marrow and now stem-cell transplantation are curative for many of these disorders. Bone marrow and stem cell transplants, however, are subject to the same rejection mechanisms as solid organ transplants. Advances in graft tolerance will be necessary for the successful use of these therapies to correct inborn genetic mutations.

Studies in numerous laboratories are aimed at better understanding the basic biology of the immune system in order to find new diagnostic and therapeutic approaches. Translational medicine is aimed at bringing these new insights to patients to treat, prevent, or cure disease. Clinical trials are necessary to test these new approaches. All of this work is ongoing at Northwestern Medicine in almost every department and across a very large number of diseases.
“Inflammation is the body’s response to tissue damage of any kind. It evolved as a way to fight off pathogens, such as bacteria, and to heal wounds. However, the inflammatory response is a double-edged sword: Virtually all acquired diseases are due to inflammation that is out of control, self-directed, or in the wrong place at the wrong time. Understanding the basic cellular and molecular biology of the inflammatory response is leading to knowledge of ways to control it. This, in turn, will lead to new and better therapies for a wide variety of maladies including atherosclerosis, autoimmune diseases, and even cancer.”

William A. Muller, MD, PhD, Magerstadt Professor and Chairman, Department of Pathology, Northwestern University Feinberg School of Medicine

THROUGH NORTHWESTERN MEDICINE, WE INTEND TO CREATE A NATIONAL EPICENTER FOR HEALTHCARE, EDUCATION, RESEARCH, COMMUNITY SERVICE, AND ADVOCACY.

NORTHWESTERN MEDICINE

Northwestern Memorial Hospital and Northwestern University Feinberg School of Medicine are seeking to impact the health of humankind through Northwestern Medicine. We aspire to be the destination of choice for people seeking quality healthcare; for those who provide, support, and advance that care through leading-edge treatments and breakthrough discoveries; and for people who share our passion for educating future physicians and scientists. Our commitment to transform healthcare and to be among the nation’s top academic medical centers will be accomplished through innovation and excellence.

As an innovation engine, Inflammation/Autoimmunity/Immunology is a crucial area for research ingenuity and discovery at Northwestern. We invite interested friends to join us by supporting our exceptional faculty scientists, their breakthrough studies, and the therapeutics they develop to help individuals who suffer from the myriad of diseases that are associated with immunologic and inflammatory events.