BIOGRAPHICAL SKETCH

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NAME: Rosenstein, Rachel, K.

eRA COMMONS USER NAME (credential, e.g., agency login): RROSENSTEIN

POSITION TITLE: Assistant Professor, Internal Medicine, Hackensack Meridian School of Medicine

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Princeton University – Princeton, NJ	AB	05/2005	Molecular Biology
Yale University – New Haven, CT	PhD	05/2012	Immunobiology
Yale University – New Haven, CT	MD	05/2013	Medicine
The Mount Sinai Hospital – New York, NY	Intern	06/2014	Internal Medicine
New York University – New York, NY	Resident	06/2017	Dermatology
National Institutes of Health – Bethesda, MD	Fellow	08/2019	Dermatology

A. Personal Statement

My research is focused on cutaneous inflammatory and fibrotic diseases, with a specific interest in cutaneous chronic graft-versus-host disease (cGVHD) in the setting of allogeneic hematopoietic stem cell transplantation. I plan to utilize single-cell transcriptomic analyses to identify new diagnostic and prognostic biomarkers of disease and therapeutic targets. My prior experiences in molecular genetics, genomics, and immunology along with my clinical training in dermatology and human-based research have provided a solid background for these investigations. During my undergraduate years, I pursued *in vitro* mechanistic studies of transcription factor processing. In the early years of genomics, I performed microarray studies to better understand yeast metabolism. During my PhD with Dr. Ruslan Medzhitov, I pursued basic immunology research in a murine system, studying the mechanisms of allergen sensing, culminating in the publication of multiple highly cited papers. During medical school and residency, I gained expertise in clinical care and pursued projects related to cutaneous inflammatory diseases and cutaneous disease in immunocompromised patients.

As a clinical fellow at the NIH, I conducted human-based research, ranging from therapeutic trials to translational studies. Through a highly collaborative in-depth evaluation of a kidney transplant recipient with a rare human polyomavirus 7-associated eruption, I gained experience with human immunophenotyping and microbial sequencing, including shotgun metagenomics and RNA sequencing. For my primary fellowship project, I utilized my prior experience in genomics and immunology to analyze bulk and single-cell transcriptomic data in human cutaneous sclerotic cGVHD. I identified both inflammatory and fibrotic pathways activated in affected skin, specific cell types with increased prevalence in affected skin, and preliminary data suggesting a role for multiple fibrotic genes as plasma biomarkers. I plan to follow up on this work by analyzing patients with early sclerotic cGVHD over multiple timepoints to better understand the connection between inflammation and fibrosis, particularly with a goal of elucidating the contribution of T cell populations. The

ultimate goal of this research is to use transcriptomics to identify new treatment targets and biomarkers to optimize the clinical evaluation and treatment of patients with sclerotic cGVHD.

I have been recognized with honors at each stage of my career, including honors for undergraduate scholarship, medical school performance, PhD dissertation, and clinical and research productivity during residency.

B. Positions and Honors

Research positions:

06/03-08/03	Summer Undergraduate Research Fellow, Molecular Genetics, University of Texas Southwestern Medical Center, PIs: Drs. Michael Brown and Joseph Goldstein
01/04-05/05	Undergraduate Senior Thesis research, Genomics Institute, Princeton University, PI: Dr. David Botstein
01/08-02/12	PhD research, Immunobiology, Yale University, PI: Dr. Ruslan Medzhitov
09/16-06/17	Residency research, Rheumatology, New York University, PI: Dr. Jose Scher
08/17-08/19	Scholar in Translational research, Dermatology, NIAMS, NIH, PI: Dr. Edward Cowen
09/20-	Assistant Professor, Internal Medicine, Dermatology division, Hackensack Meridian School of Medicine/Center for Discovery and Innovation

Academic and Professional achievements and honors:

2005	Magna cum laude in Molecular Biology, Princeton University
2012	Keystone Symposia scholarship to attend The Biology of Cytokines conference
2013	Doctor of Medicine cum laude, "conferred on students whose academic performance shows unusual merit," Yale School of Medicine
2013	The M.D./Ph.D. Thesis Prize, for the most outstanding MD/PhD dissertation
2017	The George Lipkin, MD Prize, for the resident who is an excellent clinician with scholarly interest and research productivity
2017	Certification as a Diplomate of the American Board of Dermatology
2017	Maryland medical license certification
2020	New Jersey medical license certification

Other Experience and Professional Memberships:

2005-2007	Sigma Xi Research Society
2014-	American Academy of Dermatology
2015-	Women's Dermatologic Society
2018-	Society For Investigative Dermatology
2018-	Medical Dermatology Society

Ad-Hoc Journal article reviewer for: Journal of the American Academy of Dermatology, Journal of Investigative Dermatology, JAMA Dermatology, British Journal of Dermatology, Drug Safety, and Pediatric Allergy, Immunology, and Pulmonology.

C. Contributions to Science

My bibliography: https://www.ncbi.nlm.nih.gov/myncbi/109IuLCyo6JAe/bibliography/public/

1. Yeast genomics:
As an undergraduate, I had my first research experience in the molecular genetics laboratory of Drs. Michael Brown and Joseph Goldstein where I characterized the Regulated Intramembrane Proteolysis of the transcription factor LZIP and gained inspiration for my future career as a physician-scientist from the influence that their basic science research has had on clinical medicine. My undergraduate thesis in the laboratory of Dr. David Botstein offered an introduction to genomics and microarray technology by studying the homeostatic response to change in growth rate of steady-state cultures of *Saccharomyces cerevisiae*.

a. Brauer, M.J., Huttenhower, C., Airoldi, E.M., **Rosenstein, R.,** Matese, J.C., Gresham, D., Boer, V.M., Troyanskaya, O.G., and Botstein, D. (2008). Coordination of growth rate, cell cycle, stress response, and metabolic activity in yeast. Mol Biol Cell 19, 352-367.

2. Type 2 immunity and cell signaling:
Allergic diseases represent a significant burden in industrialized countries, but why and how the immune system responds to allergens remain largely unknown. During my PhD, I studied the mechanisms of how two different types of allergens stimulate immune responses. We characterized the downstream signaling pathways activated by cysteine protease allergens, that include some of the most clinically significant allergens like house dust mite allergen, in basophils. In addition, we examined how phospholipase A2, a conserved component of venoms from multiple species and the major allergen in bee venom, is sensed by the innate immune system and induces a type 2 immune response in mice. We found that the innate immune system can detect the activity of venoms and induce a protective immune response against a venom toxin. Our studies and discussions culminated in the publication of a perspective which suggested that allergic immunity has an important role in host defense against noxious environmental substances, hematophagous fluids, environmental xenobiotics, and irritants. We argued that when targeted appropriately, allergic reactions can be beneficial and that allergic hypersensitivity may have evolved to elicit anticipatory responses and to promote avoidance of suboptimal environments.

a. Palm, N.W.*, **Rosenstein, R.K.*,** and Medzhitov, R. (2012). Allergic host defenses. Nature 484, 465-472.
b. Palm, N.W.*, **Rosenstein, R.K.*,** Yu, S., Schenten, D.D., Florsheim, E., and Medzhitov, R. (2013). Bee venom phospholipase A2 induces a primary type 2 response that is dependent on the receptor ST2 and confers protective immunity. Immunity 39, 976-85.
c. Rosenstein, R.K., Bezbradica, J.S., Yu, S., Medzhitov, R. (2014). Signaling pathways activated by a protease allergen in basophils. PNAS 111, E4963-71.
d. Bezbradica, J.S., **Rosenstein, R.K.,** DeMarco, R.A., Brodsky, I., Medzhitov, R (2014). A role for the ITAM signaling module in specifying cytokine-receptor functions. Nature Immunology 15, 333-342.

3. Inflammatory and autoimmune diseases:
I have an interest in cutaneous inflammatory diseases as well as skin diseases that affect the immunocompromised patient. I have published a review book chapter on dermatologic diseases in transplant recipients and a case of a solid organ transplant recipient with a rare cutaneous infection, trichodysplasia spinulosa. In a recent multidisciplinary, translational study, I explored host-pathogen interactions in a renal transplant recipient with human polyomavirus 7-associated skin disease. I have published additional cases on the cutaneous manifestations of dermatomyositis and sarcoidosis, among others.

- **a. Rosenstein, R.K.,** Panush, R.S., Kramer, N., and Rosenstein, E.D. (2014). Hypereosinophilia and seroconversion of rheumatoid arthritis. Clinical Rheumatology 33, 1685-1688.
- **b. Rosenstein, R.K.** and Colegio, O.R. (2015). "Dermatologic Diseases in Organ Transplant Recipients and Hematopoietic Stem Cell Recipients." *Textbook of Internal Medicine: An Intensive Board Review Book with 1000 Multiple-choice Questions.*
- **c. Rosenstein, R.K.,** Martires, K., Christman, M., Terushkin, V., Meehan, S.A., Seminara, N., Golden, B.D., and Franks, A.G. Jr. (2016). Dermatomyositis, clinically presenting with cutaneous ulcers, with histopathologic evidence of perforating collagenosis. Dermatology Online Journal, 22 (12).

d. **Rosenstein, R.K.**, Ko, C.J., and Colegio, O.R. (2017). Trichodysplasia spinulosa. Transplantation. 101, e314.
e. **Rosenstein, R.K.,** Pastrana, D.V., Starrett, G.J., Sapio, M.R., Hill, N.T., Jo, J., Lee, C.R., Iadarola, M.J., Buck, C.B., Kong, H.H., Brownell, I., Cowen, E.W. (2021). Host-pathogen interactions in human polyomavirus 7-associated pruritic skin eruption. Journal of Investigative Dermatology. 141, 1344-1348.

4. Chronic graft-versus-host disease:
While investigating the pathogenesis of cutaneous sclerotic cGVHD at the NIH, I also participated in multiple other clinical research projects related to cGVHD. We investigated the effect on quality of life in patients with skin of color with cGVHD. We compiled a multi-institutional case series of patients with calcinosis cutis in the setting of skin cGVHD, exposing a little recognized association. We also explored rehabilitation interventions in the management of patients with cGVHD.

a. Smith, Z.I., **Rosenstein, R.K.**, Banerjee, S., Pichard, D.C., Pavletic, S.Z., Cowen, E.W. (2020). Quality of Life in Patients With Skin of Color and Chronic Graft-vs-Host Disease. JAMA Dermatology 156, 589-590.
b. Saardi, K.M.*, **Rosenstein, R.K.*,** Anadkat, M.J., Micheletti, R.G., Schiffenbauer, A.I., Pichard, D.C., Pavletic, S.Z., Cowen, E.W. (2020). Calcinosis cutis in the setting of chronic skin graft-versus-host disease. JAMA Dermatology 156, 814-817.
c. Moles-Poveda P, Comis LE, Joe GO, Mitchell SA, Pichard DC, **Rosenstein RK**, Solomon B, Pavletic SZ, Cowen EW. (2021). Rehabilitation interventions in the multidisciplinary management of patients with sclerotic graft-versus-host disease of the skin and fascia. Arch Phys Med Rehabil 102, 776-788.