Nasser Rusan: Scoping out centrosomes

Marie Anne O'Donnell

Rusan investigates how centrosomes control cell behavior and differentiation during development.

Deconstructing math and physics problems to their core principles was Nasser Rusan's main interest while growing up in Amman, Jordan, but his high school grades diverted him from the de facto path of pursuing a medical degree. Instead, the "Golden Ticket" of an American passport transported Rusan to the University of Massachusetts-Amherst, where he rediscovered his strength in problem solving as a biology student. While looking for a research laboratory placement to boost his CV, Rusan met Dr. Chris Woodcock, a professor studying nuclear architecture who told him, "You wouldn't have much fun in my lab, talk to this person upstairs, Pat Wadsworth." Rusan began his research as an undergraduate in the Wadsworth lab and continued there for his PhD, where he trained as a microscopist and studied mitosis in cultured mammalian cells. Rusan became "hooked on watching microtubules assemble spindles and move chromosomes." In retrospect, Rusan appreciates that he had miraculously landed in the middle of two revolutionary cell biology technologies (spinning disc confocal microscopy and GFP) as they were just taking off. Rusan graduated from Wadsworth's laboratory in 2005. A postdoc with Mark Peifer at the University of North Carolina brought Rusan into the "strange land of developmental biology and genetics, where they use 40× objectives on upright microscopes." Despite this initial difference in imaging scale, the cell and developmental biology worlds merged into one for Rusan during his postdoctoral studies and this is where his laboratory operates today, within the National Heart, Lung, and Blood Institute since 2011.

We contacted Rusan to find out more.

What drew you to study the functions of centrosomes in cell biology?

I have been interested in how microtubules are born, behave, and self-organize for nearly 20 years. Early in my postdoc, I was imaging *Drosophila* neural stem cells and noticed that spindle assembly and the centrosome cycle were unique (1). It was fascinating to watch something that, according to text books, was not supposed to happen. From then on, I focused on understanding how these stem cells use centrosomes to ensure asymmetric division, proper differentiation, and accurate brain development. This finding coincided with a revolution in the centrosome field where key components were identified and the mad rush to investigate their function was just beginning. Now, the centrosome field is in a second wave of discovery where complex assembly and regulatory mechanisms are being revealed. I'm excited that my laboratory is part of this field.

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What are you currently working on? What is up next for you?

We spent a significant amount of time streamlining a system to investigate multifunctional centrosome proteins (2). Half of my laboratory is trying to understand functional diversity of proteins across tissues and time. How does the same protein play unique roles in different developmental stages, cell types, and cell cycle stages? We use *Drosophila* to tackle this diversity, as it affords the tissue and time variables we seek. This line of research is born out of my interest in how diseases can be restricted to certain organs and why they manifest at different stages of life. Our in vivo approach has uncovered unexpected new roles for centrosome proteins in interphase neural stem cells (3), during embryogenesis (4), and during spermatogenesis (5), to name a few.

The rest of my laboratory has taken a turn away from centrosomes into an uncomfortable area for us, developmental neurobiology (6). This direction started as a project aimed at investigating centrosomes as microcephaly-suppressor organelles. We have now expanded our research well beyond the centrosome, taking a hardcore cell biology approach to understanding brain development using all the latest imaging technologies.

Nasser Rusan.

What kind of approach do you bring to your work?

I start by thinking about the final product. What do we want to achieve? I am always convinced that we will encounter zero obstacles. These optimistic discussions with laboratory members and colleagues are a lot of fun. Then comes logistics, which is my favorite part of planning a project. How do we chart a path to that perfect product? Here is where our giant list of experiments, ideas, and tasks fiercely collides with resource limitations and experimental realities. Important to the success of this approach is to give each laboratory member the opportunity to dream about that awesome final product and have them take the lead in charting the path. My job is to help them along the way while infusing my "just try it" attitude.

What did you learn during your training that prepared you for being a group leader?

As a graduate student, two things stand out. First, the amazing opportunity to attend a lot of meetings where presenting my work and networking became second nature. Second, gaining a deep understanding of light microscopy, which has been the foundation of my career. As a postdoc with Mark Peifer, I

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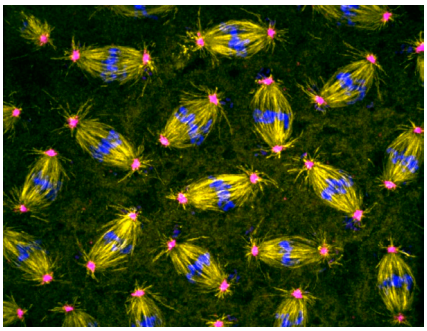

Mitotic spindles during *Drosophila* syncytial divisions. Embryo is stained for micorotubules (yellow), centrosomes (pink), and chromosomes (blue). IMAGE COURTESY OF DOROTHY A. LERIT.

learned how to focus my scientific questions, think deeply about mechanism, and better communicate my science. The most critical aspect of my postdoc, however, was the freedom to develop an independent research program and establish a critical collaboration with Greg Rogers (now a PI at the University of Arizona), who has had a huge impact on my career for the past 13 years. At the end of my postdoc, I felt like a PI in full command of my research. The opportunities provided by Mark fully shaped my philosophy toward the postdoctoral position. My goal is to provide the same opportunity to my postdocs.

What I wasn't prepared for was spending my life in 15-minute increments. As PIs, we must constantly and seamlessly switch from one task to another. First writing, then talking to a postdoc about careers, reviewing a paper, assembling a talk, fixing the microscope because someone "can't see anything," pushing flies, talking with a collaborator, completing a *JCB* interview, and finally back to writing. Once you master the 15-minute dance, you'll be rocking it as a PI. To rein this in a bit, I now block off Tuesday and Wednesday afternoons; those 8 hours are mine . . . sometimes.

What has been the biggest challenge in your career so far?

As a postdoc, but mostly as a PI, I struggled to find a balance between pursuing the most exciting scientific questions and ensuring the high productivity needed to move my career forward. Before running my laboratory, I promised myself I would simply enjoy the science, but the truth is that pursuing job security made its way onto the priority list, and it influenced my scientific choices. It is quite romantic when I read that someone followed what they deemed exciting science, threw caution to the wind, and had fun. For me, business superseded fun. It seems unbecoming of a "real" scientist to admit I might have taken a safer route to publishing manuscripts to move beyond the tenure-track period. I believe that my laboratory has published many great papers and I am very proud of each one, but it was a delicate balance and I definitely had to suppress my curiosity for the sake of measurable productivity. I suspect this is quite common and, if so, it is interesting to think about how this balance impacts discovery in general. I am excited for the next stage of my career.

What is the best advice you have been given?

I am definitely influenced by the actions of others more than by statements hurled my way. I have had some great role models in my life: Pat, Mark, and Greg are the most notable, but there are many others, both in my professional and personal lives. The summary of it all is: work hard, no result is a bad result, say as much as the data will allow, almost all mountains are molehills, be a genuine and nice person, and stand your ground when necessary.

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What hobbies do you have?

Most of my free time is spent with my wife and two kids. We enjoy the outdoors and make a point of hiking every weekend. My hobbies are many and ever changing. In the last few years it has been car mechanics, ham radio, scroll sawing, and gardening. These days it is smoking meat, boxing, and a nonscience-related company I started with a friend in 2016. The one constant hobby I have had for the past 17 years is ultralight backpacking. Calculating and minimizing every ounce I carry and every calorie I consume lends itself well to a scientist.

Any tips for a successful research career?

I agree with most advice others offer—recognize your weaknesses, surround yourself with great people, establish strong collaborations, think far in advance but never move beyond a task until it's complete, and find mentors you can openly talk to about anything. Critical for me was having a supportive spouse that shouldered most of the heavy lifting for our family the past 13 years. I'll offer two pieces of advice you don't hear too often. First, did you know that almost every PI has once said, "We are not trained for our jobs"? Meaning, we go from bench scientist to becoming professional writers, teachers, fund raisers, and personnel managers. True, there is no system in place to prepare for this transition, but if you aspire to become a PI, I recommend taking matters into your own hands to gain "PI training." Write your own papers, communicate with reviewers and editors, teach classes, organize seminars, write grants, attend meetings, manage a team of students, and take notes on how you want to run your future laboratory. This, however, cannot be at the expense of doing great science and publishing papers. Also, gain perspective by discussing issues with positive, effective managers; people that see both sides of every issue and make decisions based more on information and less on emotion. Then, the only thing left is to master the 15-minute dance. Second, find an environment that functions not just as a team, but as a family where collective efforts are aimed at moving everyone forward. As a PI, I've tried my best to create a laboratory environment where each member believes in the family philosophy—mutual respect, tough love, open and candid communication, preparing in-house to face the world outside, and sharing ideas, reagents, and tools. I believe that this type of environment provides the best opportunity for a sustained, successful, and happy research career.

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Nasser Rusan with his wife Susanne and two kids, Rania and Rami.