Erik Biessen: "I would love to explore how the brain regulates inflammation"

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Prof. Erik Biessen graduated in Biophysical Chemistry at Groningen University, Netherlands (1985). He joined the Division of Biopharmaceutics of Leiden University as a post-doctoral fellow and was selected for the prestigious Netherlands Heart Foundation (NHF) funded Molecular Cardiology Program to become Established Investigator in 2001. Since 2007 he is heading the Experimental Vascular Pathology group of CARIM (MUMC), with a part-time affiliation at the Institute for Molecular Cardiovascular Research of RWTH Aachen. Dr. Biessen aims for curiosity-driven cross-disciplinary research with an open eye for valorization of findings. Through the years his focus has shifted from biophysical chemistry, via medicinal chemistry and drug targeting to cardiovascular pathophysiology research, deploying a systems medicine approach.

- **What does your main research focus nowadays?**

My primary focus is on cardiovascular immunology, specifically the inflammatory processes underlying cardiovascular diseases. I take a global approach, connecting patterns not just in the vascular system but also in the heart and related comorbidities such as diabetes, obesity, and liver disease. My aim is to untangle common pathways shared among these conditions and understand how they interconnect.

- **How do you approach this research? Do you use any special tools?**

My background is in physical chemistry, so my path into medical research was somewhat unexpected. During my first postdoc, I designed glycolipids with potent cholesterol-lowering activity, which led me into cardiovascular research. My supervisor at the time also had an interest in this field, and through a career project funded by the Netherlands Heart Foundation, I became deeply involved in studying cardiovascular diseases.

In the early 2000s, research focused on lipids and cholesterol as primary disease drivers. However, I suspected there were additional factors at play, particularly inflammation. Initially, when I was in Leiden, our findings were based on mouse models, but I soon realized human disease differs significantly from mouse models due to variations in anatomy, diet, and immune systems. This realization led me to Maastricht and the University Hospital, where I had access to human biobanks. Seeing a human plaque for the first time was eye-opening—it looked completely different from mouse models. That experience prompted me to integrate data science and omics analysis into my research, using human tissue data to generate hypotheses, which we then validate in mouse models.

- **What kind of omics techniques do you use?**

We primarily use bulk RNA sequencing, complemented by metabolomics, lipidomics, and proteomics. Our current cohort is much larger than our previous one—24 times bigger—which gives us more statistical power. In the past four years, we have also incorporated spatial techniques, such as single-cell analysis, to determine how cells interact within tissue environments.

We analyze spatial patterns in tissue samples, identifying areas where certain metabolites or inflammatory cells cluster. For example, by looking at metabolic layers alongside phenotypic data, we can understand how inflammation manifests in different tissue regions. This allows us to explore interactions that might be key in disease progression and could potentially be targeted therapeutically.

- **Given the influence of comorbidities in cardiology, how difficult is it to achieve**

personalized medicine for cardiovascular disease?

It is indeed challenging because cardiovascular disease is not a singular entity—it is interconnected with many other conditions, such as diabetes and liver disease. I approach this from a globalist perspective, looking for shared pathways across different diseases.

Recent advances in single-cell analysis and precision medicine have led to a fragmentation of disease understanding. This makes it more difficult for pharmaceutical companies to develop broad treatments. Instead of aiming for highly individualized treatments, I support a precision medicine approach where we use a larger battery of treatments and companion diagnostics to identify which patients will benefit most from specific drugs.

- **This approach is also used in cancer research.**

Yes, oncology is ahead in this regard, likely because cancer has long been studied at a molecular level. However, there are promising developments in cardiovascular disease as well. For instance, new diabetes and obesity drugs have been shown to reduce cardiovascular risk. While we are still at the beginning of understanding these effects, I believe such drugs will play a significant role in future treatments.

- **How do you manage mentoring students while maintaining your research activities?**

Our group consists of about 25-30 people, and I am fortunate to have a formidable team of experienced researchers. I directly supervise three to four PhD students, while senior staff members supervise others. Additionally, I have a co-chair who has developed her own research line and now leads PhD students as well.

I enjoy mentoring, but I have noticed a shift in student expectations over the years. They now prefer closer, more frequent supervision. When I was a PhD student, I met with my supervisor only a few times per year, which fostered independence but was inefficient. Today, I meet with my students weekly or biweekly and have informal discussions almost daily. I try to balance close guidance with encouraging independence, helping them grow as researchers without micromanaging them.

- **If you had unlimited funding and technology, what major challenge would you focus on?**

Scientifically, I would love to explore how the brain regulates inflammation, particularly in relation to diabetes. Brain-immune interactions are a fascinating and emerging field.

From a healthcare perspective, the biggest challenge will be ensuring an excellent quality of life after major cardiovascular events, such as heart attacks or heart failure. As the population ages, we need better strategies for recovery and long-term management.

- **Do you have any collaborations with CNIC's researchers?**

Yes, I do. I know Carlos Pérez Medina, and we have two ongoing mutual projects. We were connected through a collaborator in Bordeaux, who is an expert in antibody development. He brought us together, and our collaboration started about 3-4 years ago, just before the COVID-19 pandemic.

Interestingly, before that, without me knowing, I was already connected through another collaborator, Jacob Bentzon. I had collaborated with him in the early 2000s, and he was also involved in transgenic pig research. My collaboration with him was another key link to CNC.

- **What are your impressions of our institute?**

I am impressed. The infrastructure is well-organized, with centralized platforms and expert staff available on-site. This setup fosters collaboration and efficiency. It is something I hope to advocate for in Maastricht, as having a centralized, well-equipped research institute benefits both researchers and the advancement of science.

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