

Neurovirology: neurotropic viruses and the brain



Sunit K Singh speaks to Hannah Branch, Commissioning Editor

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Sunit K Singh obtained a Bachelor's degree from GB Pant University of Agriculture and Technology (India) followed by his Master's degree from the Central Institute of Fisheries Education (India). Upon the completion of his Master's degree, Singh moved to the University of Wuerzburg (Germany) to complete his PhD degree in the field of Molecular Infection Biology. Subsequently, he undertook his postdoctoral training at Yale University School of Medicine (CT, USA) and at the University of California Davis Medical Center (CA, USA). Singh has also been visiting faculty at the Albert Einstein College of Medicine (NY, USA), Department of Pathology and Immunology, University of Geneva (Switzerland) and the Institute of Parasitology (Czech Republic). At present, he is a permanent member of faculty in the Section of Infectious Diseases and Immunobiology Centre for Cellular and Molecular Biology (CCMB; India) and is leading a research group in the area of neurovirology there. Singh has been an author of a number of papers published in peer-reviewed journals, and has been honored with several awards, including the Skinner Memorial Award, Young Scientist Award, Travel Grant Award and the NIH-Fogarty Fellowship. In addition, he is a valued editorial board member of several journals, including *Future Microbiology*.

■ Could you briefly summarize your career to date?

I started my education in a small town Daryabad, which is in the Barabanki district, Uttar Pradesh, India. After completing my high-school education in Science subjects, I moved to Govt. Inter College, Faizabad for my Intermediate education in Biological Sciences. It would not be wrong to say that I had made up my mind by this time that biological science was going to be my preferred area for higher education. I always had an inclination to understand mammalian anatomy and physiology, and of course infectious diseases that are a threat to society. I still have a passion for learning and teaching subjects related to human anatomy, physiology and infection biology.

After my Intermediate education, I joined the College of Fisheries Sciences, GB Pant University of Agriculture and Technology, Pantnagar to complete my Bachelor's degree program (B.F.Sc.) in the area of Fisheries Science. I was awarded the Vice Chancellor's gold medal for my academic achievements in the Bachelor's degree Program. Soon after, I completed my Master's degree in Fisheries Sciences (M.F.Sc) at the Central Institute of Fisheries Education (CIFE), India. This was the time when the interdisciplinary era of

biological sciences started; however, it was in its infancy. As previously explained, I always had a keen interest to study the aspects of biology related to humans. It was a big challenge for me to choose a new area after my Master's degree program, but I opted to do so because I had a special interest in understanding the molecular mechanisms of pathogenesis utilized by various viruses.

The University of Wuerzburg is one of the most prestigious universities of Germany, the contribution of which is immense in the field of science. Therefore, I decided to complete my PhD in Molecular Infection Biology at the University of Wuerzburg. I applied to Professor Hermann J. Girschick's laboratory and he gladly accepted my candidature for the PhD position. After successful completion of my PhD in the area of Molecular Infection Biology, I moved to Yale University School of Medicine (CT, USA) as a postdoctoral associate. After spending a brief time at Yale, I moved to the University of California, Davis, USA as a post-doctoral scholar. I received the offer for a faculty position at the prestigious Centre for Cellular and Molecular Biology (CCMB), Hyderabad during my stay at the University of California, Davis (CA, USA).

I emphasize here that science must accelerate the pace of interdisciplinary approaches to study. An interdisciplinary view of science provides a broad outlook for understanding scientific problems and also inculcates the ability to address scientific issues from diverse angles.

■ **How did the time you spent completing your postdoctoral training at Yale University & the University of California Davis Medical Center influence your chosen research area?**

My stay at Yale University School of Medicine and University of California Davis Medical Center was influential and really helped me choose my current area of work. I was trained in the area of infectious diseases during my PhD at the University of Wuerzburg and Yale University School of Medicine. Additionally, I received training in the area of neuroinflammation during my postdoctoral training at the University of California, Davis. These various training programs provided me with a base to merge the knowledge acquired at both places and use it for something new. Therefore, I started my research group in the field of neurovirology at CCMB, Hyderabad.

■ **What is it about neurovirology & neuroinflammation that interests you?**

Whenever we think about neurovirology and neuroinflammation, two basic questions come to mind. Question one: how do these viruses cross the blood–brain barrier and enter the brain? Question two: how do neuroinflammatory events begin in the CNS after viral entry? Many neurotropic viruses take various other routes other than the blood–brain barrier in order to enter the brain. What are those alternate routes and mechanisms of entry of viruses into brain? These are the major questions that my laboratory is trying to understand by utilizing various advanced molecular biological techniques and other interdisciplinary approaches.

■ **In your opinion, how could understanding the mechanism of HIV neuropathogenesis & immune activation impact humans & healthcare?**

NeuroAIDS is having a significant impact on the life of HIV patients. In advanced stages, it leads to several motor and cognitive dysfunctions among AIDS patients. Therefore, it is important to understand the basic mechanisms involved in HIV-induced neuroinflammation, which might form a basis for therapeutics development for the betterment of HIV patients. There are

still many challenges to address in therapeutics development for various neuroviral infections. The major challenges are associated with drug delivery and targeting to the brain.

■ **You also conduct research into neuroinfections by flaviviruses. What is the significance of this work?**

Flaviviruses contribute a large total disease burden. They are considered to be a major threat across the entire world, especially in southeast Asian countries. The infections caused by flaviviruses have increased many-fold recently due to various factors including changes in agricultural practices, deforestation and global travel and trade. Many flaviviruses also infect the brain, such as Japanese encephalitis viruses and Dengue virus, among others. These viruses still require much more research from a neuroinfections perspective. Therefore, my research group is also trying to understand the mechanisms of neuroinfection utilized by these flaviviruses.

■ **What challenges do you face in your research & what steps do you take to overcome them?**

There are many types of challenges that scientists face in their day-to-day life, such as the arrangement of funding and establishment of laboratory infrastructure. Therefore, hard work with a focused approach and a patient attitude is key for handling such issues.

■ **You have been honored with a number of awards. Which award are you most proud of & why?**

I have been honored with many awards; however, the award that was the first one I received and was achieved during my student life holds a special place in my heart. Therefore, I would say that the “Vice Chancellor’s Gold Medal” that I was honored with during my studies was a special one. I have also been honored by the Young Scientist award, Skinner Memorial award and various other awards from time to time in the latter part of my academic carrier.

■ **You have recently published two books on neurovirology. What areas are covered by these books & how might they be useful to the scientific community?**

The two books are titled ‘Neuroviral Infections: General Principles and DNA Viruses’ and ‘Neuroviral Infections: RNA viruses and Retroviruses’, published through the Taylor & Francis group of publishers/CRC Press. Neurovirology is an

interdisciplinary field that represents a combination of virology, clinical neuroscience, molecular biology and immunology.

The title 'Neuroviral Infections: General Principles and DNA Viruses' has been divided into two parts. Part I, 'Principles of Viral Infections of the Nervous System', includes information on the history of neurovirology, neuroinflammation and animal models in neurovirology, and summarizes recent methods of diagnosis of the neuroviral infections and new therapeutic approaches. Part II, "Neurotropic DNA Viruses and Their Diseases," contains chapters on the major neurotropic DNA viruses and virus families.

The title "Neuroviral Infections: RNA viruses and Retroviruses" has also been divided into two parts. Part I includes the major RNA virus chapters and Part II deals with the specific information on major retroviruses and their diseases.

Each chapter in both the books describes in detail about the epidemiology, clinical features, mechanisms of pathogenesis, and diagnostic and therapeutic approaches.

The aim of these books is to present an up-to-date overview on major neuroviral infections caused by various viruses to virologists, immunologists and infectious diseases specialists. We hope that these titles will serve as a useful resource for the researchers and general readers interested in the area of viral infections of the CNS.

■ **Where do you see the neurovirology field in the next 10 years?**

Neurovirology is quite a new branch of virology. I see immense potential in this field for understanding the disease challenges as posed by neurotropic viruses. There is still a huge disease burden of neuroviral infections in the developing and developed world, which needs to be tackled by

boosting the funding into neuroviral research. I see the development of antiviral drugs as another area that is full of potential. We must develop our armamentarium of antiviral drugs to deal with the development of drug resistance in viruses. We do not have many antiviral drugs, therefore we must have a solid plan to add new one. I see a great potential in these fields in coming years, from a human health point of view.

■ **If resources & funding were unlimited, what research would you like to conduct & why?**

If resources were unlimited then I would do so much in terms of neuroviral research. There are always some high-risk projects, where you have no clue of the outcome; however, those are very important from human health point of view. Additionally, they require more funding in terms of their implementation and management. I would like to explore such areas of research further in the case of there being availability of unlimited funding and resources. I think such studies provide new findings that open new directions for research.

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