Brij Kishore Tyagi *Editor*

Lymphatic Filariasis

Epidemiology, Treatment and Prevention - The Indian Perspective

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Dedicated to
my colleagues
and
India's two unparalleled filariasis experts
Dr. V. Kumaraswamy and Dr. R. Rajendran

Foreword

This timely book conveys the scale and scope of contemporary expertise on human lymphatic filariasis (LF) in India. Professor Tyagi brings together 24 diverse chapters by 54 authors whose knowledge and research span much wider range of interests than are being applied in the Global Programme to Eliminate Lymphatic Filariasis (GPELF) launched in year 2000, technically led by the World Health Organization (WHO) following World Health Assembly Resolution 50.29 "Elimination of lymphatic filariasis as a public health problem" supported by the Global Alliance to Eliminate Lymphatic Filariasis (GAELF).

Among more than 80 countries where LF was endemic until the end of the twentieth century, India had the most human cases and continues with the greatest national LF burden, while LF has already been eliminated as a public health problem in at least 20 countries, including neighbouring China and Sri Lanka. The GPELF strategy relies upon complete coverage of the human population with annual free mass drug administration (MDA) for at least 5 years, by giving oral diethylcarbamazine citrate (DEC 6 mg/kg) together with ivermectin (200 mcg/kg) or albendazole (400 mg) yielding general anthelmintic benefits. Also therapeutic treatment (morbidity management) is provided for patients with symptomatic elephantiasis, sometimes involving surgical alleviation. Indian ayurvedic traditions bring additional benefits to LF sufferers but may reduce compliance with effective MDA by the community, perhaps accounting for disappointing coverage rates in many districts. Even so, by year 2016, successful coverage was withdrawn from 100/130 implementation units nation-wide, harbouring 272/360 million Indian population where LF prevalence had been suppressed below the target 1% threshold.

Hence, Indian progress of the current PELF greatly exceeds the gains from the original National Filariasis Control Programme (NFCP, launched 1955) based on DEC plus vector control against *Culex quinquefasciatus* transmitted *Wuchereria bancrofti* (Bancroftian filariasis) and *Mansonia* mosquito vectors of *Brugia malayi* (Brugian filariasis). Since 2003, NFCP was incorporated into the National Vector-Borne Diseases Control Programme (NVBDCP) with Integrated Vector Management (IVM) having multi-disease impact. Chapters in this book augment the efforts and accomplishments of dedicated Filariasis Research Cells in two centres of the Indian Council of Medical Research (ICMR), namely the Centre for Research in Medical Entomology (CRME at Madurai, established 1985) and the Vector Control Research Centre (VCRC at Puducherry, established 1975).

Bringing innovative scientific technologies and state-of-the-art sociological solutions to the fore, the contents of this book are intended to illuminate some neglected aspects of the LF situation in India, including its unusual epidemiology in Andaman and Nicobar archipelagos; to describe some success stories where interventions have made exceptional gains; and thus to encourage and expedite more efficient implementation of the NPELF to the level where LF cases will die out from all Indian foci, transmission will be suppressed below the threshold for new cases to occur and LF will be eliminated as a public health problem in all states of India.

Our focus on filariasis remains vital during this decade while neglected tropical diseases are being bundled into multi-disease control programmes that should enhance operational efficiency, but risk losing specific expertise for dealing with such an intractable infection and its epidemiology.

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22nd May, 2018

Preface

Lymphatic filariasis (LF) is a group of human and animal infectious diseases caused by nematode parasites of the order Filariidae, commonly called filariae. This disease is one of the oldest and the most debilitating neglected tropical diseases (NTDs) transmitted from man to man by the bites of mosquitoes, particularly the brown-black one called *Culex quinquefasciatus*. LF is a major public health problem in many parts of the tropics, especially India which contributes as much as 40% of the total global disease burden. As a leading cause of permanent and long-term disability worldwide, the parasite infection imposes a severe physical and socioeconomic burden. In terms of economics, the burden lymphatic filariasis exacts worldwide is painfully astronomical. The World Health Organization (WHO) estimates that nearly 1.4 billion people live in high-risk areas, 120 million of which already infected with LF, and 76 million people suffering from damaged lymphatic and renal systems. Painfully, about 22 million children below 15 years of age are infected with the disease.

Southeast Asia region harbouring India as a major endemic nation is estimated with approximately 700 million people living in endemic areas constituting about 64% of the global burden with about 60 million persons (50% of the global burden) either harbouring microfilaria or suffering from clinical manifestation. All the three LF parasites, viz. *Wuchereria bancrofti*, *Brugia malayi*, and *B. timori* are prevalent in the region. *Bancroftian filariasis* transmitted by the ubiquitous principal vector, *Culex quinquefasciatus*, is the most predominant infection in the continental Asia, while Malayan infections caused by *Brugia malayi* and transmitted by *Mansonia* and *Anopheles* species are largely endemic currently in the Kerala State, peninsular India. *Brugia timori*-related filariasis does not occur in India and is predominantly present in the Indonesian Archipelago region.

Following the epoch-making advances in the field of diagnosis and treatment of the disease, the World Health Organization classified in 1997 lymphatic filariasis, along with five other infectious diseases, as eradicable or potentially eradicable. In the same year, the World Health Assembly adopted Resolution WHA 50.29, which called on Member States to initiate steps to eliminate lymphatic filariasis as a public health problem. In response to this call, the WHO launched in 2000 the Global Programme to Eliminate Lymphatic Filariasis (GPELF), of which India was a signatory, to eliminate LF as public health problem by 2020 with the following twin strategy:

1. Interrupting transmission through annual large-scale treatment programme, known as mass drug administration, implemented to cover the entire at risk population
2. Alleviating the suffering caused by LF through morbidity management and disability prevention

Being a major endemic country, the Government of India launched mass drug administration (MDA), with diethylcarbamazine citrate (DEC), foremost as a pilot project in 13 districts of 7 states in 1996. The Government of India's National Vector Borne Disease Control Programme (NVBDCP), which monitored the pilot study, upscaled the MDA to cover a population of 77 million in 2002 from 41 million during 1996–1997. Morbidity management and disability prevention are of vital public health importance and largely focus on training healthcare workers and community to dispense proper care and treatment. Only nocturnally periodic *W. bancrofti* in most endemic urban areas is being transmitted through *Cx. quinquefasciatus* bites, and it was estimated that about 2,765 infective bites would be the average exposure leading to infection in humans.

Challenges that beset India were manifold: (1) It pronounced to eliminate disease under the National Programme to Eliminate Lymphatic Filariasis (NPELF) 5 years in advance to the global scheme of elimination, i.e. by 2015 (which, in spite of achieving phenomenal success in most parts of the country, could not be eventually achieved as envisaged originally, and the next most practical date was fixed as 2018). (2) The MDA did not progress to show higher than 50% drug intake albeit appreciably high rate of drug distribution and community coverage. (3) All States/UTs did not follow uniform, regular MDAs, consequently leaving big and frequent gaps of non-distribution of the drug. (4) Populations that were endemic but left out or under-drugged for inexplainable reasons resultantly formed the 'hot spots' that manifested far higher microfilaria (*mf*) rate than the national cut-off level (1%). India demonstrated enormous progress in course of its endeavour to eliminate disease before 2015, but, sadly enough, fell far short of expectation. Close to 100 districts with huge populations live in districts highly endemic for lymphatic filariasis of 'hot spots' which proved the biggest handicap in the country's efforts to declare it free from the disease under the Global Programme to Eliminate Lymphatic Filariasis (GPELF)! To overcome this constraint, India had launched Technical Assessment Survey (TAS) to enumerate high *mf*-endemic areas in the country and implemented yet another MDA on 10 August 2016. Would this be the starting point of Ariadne's thread that would eventually lead to the exit from the labyrinth of human filaria and lay the foundations for scientifically based disease elimination, likely with the support of vector control, in the country?

Although continuously affected adversely, nevertheless, India has made great strides on many grounds in order to exercise elimination of the disease. These advancements are of global significance be it a mechanism to early diagnose a case detection, vaccine product development, and detection of parasites in the vector to study trend of the parasite evolution in nature as a warning signal. All these failures and successes need to be recounted so as to take stern measures in the future to not

repeat the disaster once again and see a smooth transition of India's endemicity to the elimination of lymphatic filariasis.

This book, which brings in here highly authentic contributions on various different subjects of lymphatic filariasis, will be an attempt to update all our knowledge on the diverse scientific inputs that have helped the nation to achieve this milestone which will be a guiding force to many other countries constantly struggling against this highly debilitating and incapacitating disease. Lymphatic filariasis, one of the most incapacitating and disfiguring vector-borne infections to the human being, will thus be the first mosquito-borne disease which will soon be declared eliminated from India and the rest of the world.

Vellore, Tamil Nadu, India
31 August 2016

Brij Kishore Tyagi

Acknowledgement

Foremost, I immensely thank the various contributors of different articles for this book, for without their timely and strong sense of commitment, it would not have been possible to give the book its present shape – highly interesting both in its content and the novelty!

In completing the rare task of editing this book, *Lymphatic Filariasis: Epidemiology, Treatment and Prevention – The Indian Perspective*, I have received generous help from many scientists and academicians from all over the world, and I feel extremely grateful to all of them.

As always in the past, I have received enormous moral support from my wife, Ajita, who has been by my side in all the difficult times that such a rare task is naturally bound to encounter!

Last but not the least, I am highly thankful to my publisher, Springer, who has put in inexorable sense of trust in my potential to complete the book in time and for bringing out the book sooner.

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About the Editor

Professor Dr. B. K. Tyagi (b. 23rd July, 1951) completed M.Sc. (Zoology) from Meerut University in 1974 and Ph.D. (Entomology/Zoology) from Garhwal University in 1978. He emeritated from ICMR in 2013, after more three decades' highly distinguished career, as Scientist 'G' (Director) & Director in-Charge at the Centre for Research in Medical Entomology, Madurai. Post-emeritation he has served as a Visiting Fellow & Professor at Bharathidasan University, Tiruchirapalli, TN, and Punjabi University, Patiala (Punjab). *Inter alia* he has been also serving as a Core Faculty of the DST-SERB School of Insect Biology at Hyderabad University, Hyderabad, and a Guest Faculty, MLS University, Udaipur. Currently, Dr. Tyagi is serving as the Advisor, SpoRIC, VIT University, Vellore, TN.

Dr. Tyagi has many achievements to his credit. With over 605 scientific titles, plus 33 books, including a WHO's Training Manual, *"Biosafety for human health and the environment in the context of the potential use of genetically modified mosquitoes (GMMs): A tool for biosafety training based on courses in Africa, Asia and Latin America, 2008–2011"*, he also holds a patent for the invention of a 'mechanical mosquito sampler' (Indian Patent # 191635). He has won the WHO-TDR First Prize in a worldwide competition in 1995 and the ICMR's prestigious Dr. MOT Iyengar Memorial Award for 2008. He has also served as the First National Representative in-Charge, National Office in India in 1981 onwards for the International Odonatological Society and as a Member in-Charge of the Odonata Specialist Group, Species Survival Commission (IUCN) in 1985 onwards. He is an editor or member of Editorial Board for >3 dozen international/national journals. He has researched extensively on all important vector-borne diseases prevalent in India and was rated amongst the top 15 most productive authors on dengue for the period 2004–2012. He is an expert member on various research committees of ICMR, DRDO, DST, DBT-RCGM etc. He was an Expert Member of the Performance Evaluation Team for the NVBDCP (GOI) in 2008 and 2013. Currently, he is President of (i) Society of Medical Arthropodology, (ii) Jodhpur Natural History Society, and (iii) Indian Dragonfly Society. He is credited to originate serial annual Conferences of Medical Arthropodology, commencing 2007, for the first time in the world. He represented India in preparing the OECD's Consensus Document on the Dengue/Yellow Fever vector mosquito, *Aedes aegypti* Linn.