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S. N. Chatterjee · Keya Chaudhuri

Outer Membrane Vesicles of Bacteria

Prof. Dr. S. N. Chatterjee
Biophysics
Formerly of Saha Institute of Nuclear
Physics
Kolkata
India

Prof. Dr. Keya Chaudhuri
Molecular and Human Genetics Division
Indian Institute of Chemical Biology
Kolkata
India

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Preface

This monograph deals with the outer membrane vesicles or OMVs of bacteria. Although some isolated studies have recently reported the production of OMVs by a few Gram-positive bacteria and other organisms, these have not yet produced any significant impact *vis-à-vis* that produced by numerous studies on Gram-negative bacteria. Accordingly, we have decided to focus on the studies of Gram-negative bacteria in general in respect of the OMVs produced by them.

A systematic study carried by one of us (SNC) along with his collaborators revealed, for the first time, the details of the production of OMVs by a Gram-negative bacterium, *Vibrio cholerae*, in the years 1966 and 1967. The OMVs were found to be produced by the bulging out of the cell wall at places, production of a constricted neck of the bulged out portion and release of the vesicular structure so produced into the extracellular medium. Besides recording these findings, it was interpreted that this phenomenon represented a novel secretory activity of the bacterial cell. This finding was, however, challenged by a contemporary publication in that the OMVs were reported to be a product of cell lysis and of artefactual origin. On the other hand, some other contemporary studies by several investigators including the original reporters (SNC and collaborators) ruled out the artefactual origin of the OMVs and established that they are produced by the cells during their active growth phase. In this context, the present authors have thought it worthwhile and relevant to record in this monograph, before it is lost or become nonavailable to future researchers, a brief revisit to the early days of the discovery of OMVs, the challenge posed against their identity as a distinct, important and useful functional entity of the Gram-negative bacteria in general and its overruling by the subsequent contemporary investigators.

Since then, studies on OMVs of Gram-negative bacteria have been progressing steadily and have brought out not only their physical and chemical nature but also, and more importantly, their diverse functions which include (1) delivery of toxins, antibiotics, etc. to host cells, (2) transfer of proteins and genetic materials to host cells, (3) cell-to-cell transfer of signals through chemical molecules, (4) elimination of competing organisms, (5) promotion of bacterial survival and pathogenesis in the host, etc. Recent studies on the proteomic profiles and biogenesis of OMVs

have been revealing many other aspects of their uses including development of diagnostic tools and vaccines and antibiotics against pathogenic bacteria. It is expected that future studies on OMVs will play a great role in the development and production of effective vaccines against pathogenic bacteria which are challenging at present the very survival of humans and animals in this world. This monograph has presented a brief account of the physiological and medical applications of OMVs and particularly their use as effective vaccine against the meningococcal diseases caused by *Neisseria meningitidis* in different countries of the world. This book has opened up the scope for doing further researches on the preparation and use of different types of OMVs, i.e. native OMVs, detergent treated OMVs, engineered recombinant OMVs, etc., and their suitability or rather efficacy as vaccines against various human and animal pathogens including *Vibrio cholerae* against which no suitable vaccine is yet available.

Ever since the discovery of OMVs in the early 1960s many illustrious investigators have contributed enormously towards the development of our knowledge of OMVs as very useful and important functional entities of Gram-negative bacteria, leading ultimately to their use as effective vaccine against the meningococcal diseases to start with. But no account of this story will ever be complete without the mention of the contributions of two prominent groups, one led by T. J. Beveridge of the University of Guelph, Guelph, Canada and the other by M. J. Kuehn of the Duke University Medical Centre, Durham, NC, USA. While the researches carried out by these two groups revealed many of the fundamental properties of OMVs and established the solid foundation for the subsequent researches on OMVs, the publication of several elegant reviews at different times by the group led by M. J. Kuehn has helped immensely in our understanding of the nature and function of OMVs and in giving indications of the direction of future researches required in this area. While this monograph has attempted to record faithfully their contributions including those of others, the authors beg to be excused for any unintentional omission.

We would like to express our sincere thanks and gratefulness to Springer-Verlag, Heidelberg, Germany for kindly agreeing to publish this monograph as Springer-Brief in Microbiology, to their publishing Editor, Dr. Britta Müller for kindly giving us their acceptance news and providing us the copy of the Publishing Agreement for SpringerBriefs and to Dr. Andrea Schlitzberger, the Project Coordinator for kindly helping us in the preparation of the manuscript and promptly answering to our day-to-day questions. We are thankful to the members of the Molecular and Human Genetics Division, CSIR-Indian Institute of Chemical Biology, Kolkata, India and particularly to Mr. Avirup Dutta who performed the transformation of all the hand drawn figures into print-friendly digital form and to Ms. Debashree Chatterjee and Mr. Arun Roy for providing technical and other help. Both of us (SNC and KC) are grateful to our respective family members for their kind patience, support and all possible help during the period we were busy with this project.

Kolkata, India

S. N. Chatterjee
Keya Chaudhuri

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