

On-Line Hemodiafiltration: The Journey and the Vision

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Claudio Ronco Vicenza



On-Line Hemodiafiltration: The Journey and the Vision

Volume Editors

Gerd Krick Bad Homburg

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Contributions to Nephrology

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Foreword

On-line hemodiafiltration represents a major technical development in the delivery of hemodialysis therapy. This modality combines the properties of increased diffusion available in current high-flux membranes with convective removal of between 6 and 30 liters per treatment. On-line hemodiafiltration requires the use of ultrapure water and online filtration of replacement fluid. This represents a major technical advance incorporated in FMC technology. This therapy has been successfully introduced in Europe and Asia and is routinely prescribed for dialysis patients in these regions.

The Fresenius Medical Care 5008 hemodialysis machine is used in the majority of on-line HDF treatments for use of HDF in Europe and other continents.

Dr. Emanuele Gatti, Management Board Member responsible for the 5008 HD machine development, made major contributions – both technically and managerially – to drive the development of the 5008 hemodialysis machine and on-line HDF.

This volume of *Contributions to Nephrology* describes the status of many on-line HDF clinical studies and the other major advances of dialysis patient care achieved during Emanuele's first 30 years in dialysis.

Emanuele and I have worked together for the past 25 years and I would like to congratulate him on his many accomplishments.

Ben Lipps, Boston

Preface

On-line HDF has gained today a high degree of popularity. The evolution of online HDF has been slow and gradual thanks to the contribution of many individuals. In Fresenius Medical Care, the tenacious activity of Dr. Gatti has guided the Company to overcome several hurdles. Development of new concepts of machine and dialyzer technologies have been the focus of several years of courageous investments, and different skills were needed to convince regulatory agencies about feasibility and safety. This book is in celebration for the 30th anniversary of Dr. Gatti's commitment to Fresenius Medical Care and a testimony of the story of success for the whole Company and for those who had the luck to share this experience in the past, present and future.

The book is divided in four parts: the first reports the technological development in both machine and fiber/dialyzer. The second represents the subsequent challenges encountered in the evolution of on-line HDF: from a host of several unmet clinical needs reported by the bedside operators (physicians and nurses) the Company has received the stimulus to identify and resolve the relevant technical issues responding to the specific needs with new products and innovative solutions. This part collects the testimony of clinical key opinion leaders who had been involved in the application of on-line HDF and had been instrumental in the evolution of some specific aspects of on-line HDF. The third is a comprehensive review of the clinical results achieved with on-line HDF since the inception of this technique to the present times in which it represents the clinical golden standard. This part includes the description of the process of adoption of on-line HDF as standard therapy in Fresenius Medical Care's own network of dialysis centers. The fourth and final part is dedicated to on-line HDF as a 'vision' for the future. New challenges and new ideas will be presented to document the never ending journey of research and development dedicated to kidney patients.

The book should hopefully fill a gap: it should teach how the vision in the future and the daily hard work together with a clear focus make the essential chemistry for success. The reader may benefit from contributions by different individuals who accompanied Dr. Gatti on the long journey. Dr. Gatti's vision

was from the beginning based on listening to the attending physicians. Many instances of practices exist in medicines that do not/cannot await for clinical trials but are increasingly introduced with the common acceptance for a seeable patient benefit. Only years after this vision came the demonstration of a significant benefit in survival of patients on on-line HDF. This would have been possible, if, even in the absence of such a recognition, the technology would have not made this modality of current use and the regulatory issues solved.

Claudio Ronco, Vicenza

Homage

Hemodiafiltration, developed from the combination of hemodialysis and hemofiltration, is considered to be the most effective current procedure to remove uremic toxins from the blood of kidney patients. Historically, the clinical use of hemodiafiltration was for many years limited due to the cost burden related to the large amount of sterile replacement fluid needed. The solution offered was an on-line preparation of replacement fluid from standard dialysate by means of membrane filtration. Industry opened to this concept quite early and worked on various technical solutions between the early 80ies and the late 90ies before real state-of-the-art systems became commercially available on a broad basis. This volume of *Contributions to Nephrology* reviews in particular the activities of initially Fresenius and later Fresenius Medical Care in this field and identifies major concepts and prototypes up to today's commercially available high-end product – the 5008 therapy system – where on-line HDF finally became integrated as a standard component.

Over the years, as a member or Chairman of the Boards of Fresenius and Fresenius Medical Care, I have initiated and encouraged the development of the scientific, medical and technical basis for a commercial on-line hemodiafiltration system. This development, and that of the accompanying innovative 5008 therapy system, was driven by the significant technical and managerial contributions of Dr. Emanuele Gatti of the Fresenius Medical Care Management Board. Through his tremendous dedication, he succeeded in overcoming multifarious hurdles to reach today's acceptance of on-line hemodiafiltration as a new standard in renal replacement therapy. His technical, managerial and business experience were unremittingly devoted to convincing the medical community and regulatory authorities of this vision of the future.

This book summarizes different aspects of this historical development pathway as experienced by those who have worked close to him for many years and who have shared his commitment to on-line hemodiafiltration.

Gerd Krick, Bad Homburg