

# Preface

In 1995, when I had the privilege to edit the first comprehensive volume on ion beam therapy (IBT), the world celebrated the 100th anniversary of Röntgen's discovery of a new kind of ionizing radiation, a finding which has significantly impacted medicine, biochemistry, and material science. X-rays became the foundation of several new disciplines for and within medicine such as radiology, radiography, radiobiology, radiation therapy, radiosurgery, but also radiation protection or X-ray technology and engineering for diagnostic and therapeutic equipment.

This new compendium will appear 110 years after Röntgen received the Nobel prize in physics, the first ever awarded. It is also the 65th anniversary of Robert R. Wilson's visionary publication in *Radiology* where he postulated the advantages of accelerated ions as a radiation source for therapeutic application. James M. Slater, the doyen of clinical proton therapy, commemorates these and other important milestones of radiation therapy that have enabled the development of IBT up to its current state in the introductory chapter of this book. The first section continues to view IBT and its place in the treatment of cancer from various angles including socioeconomic aspects.

In the second section, the physical and radiobiological fundamentals of IBT are described. Preclinical assays are presented and computer models to calculate the effects of various ions.

Clinical results cover a large part of this book because, in recent years, IBT experience has been gained for tumors of most organs. From ocular and skull base tumors to thoraco-abdominal and pelvic tumors or tumors of the extremities, promising data are reported, and it will become clear that IBT is applicable not only to fixed targets but also to highly mobile tumors that change their shape and location during a single treatment fraction.

Two sections are devoted to the technology required for IBT, from individual components to turn-key commercial concepts. Pros and cons of various accelerator types or the challenges of superconducting magnets are key topics. Beam spreading techniques, dosimetry, safety and control systems, and quality assurance

are explained, and how a gantry should be designed that offers precision, ease of handling, and maximum flexibility to the therapist.

The section *Patient Positioning and Treatment Planning* covers IBT-relevant issues of imaging, planning, positioning, and online irradiation control. Colleagues from Loma Linda, Boston, Chiba, and Jacksonville share their valuable experiences concerning the start-up of a new facility or an upgrade of an already operating center.

Radiation therapy still experiences new developments all intended for safer and more successful treatment of the patient. IBT is part of this progress and experiences significant changes itself. Despite some rather surprising recent decisions by industrial players, new facilities, will soon be able to study carefully and systematically ions of the first ten elements of the periodic table to find out which ions are best suited for which indications. However, IBT will not only be judged on its clinical excellence. In a world of health economics, any new diagnostic or treatment modality will have to compete economically with existing devices or techniques. New technical concepts which promise to lower the cost of IBT by promoting smaller units or single-room facilities will, therefore, complete the last section on *Future Developments*.

This book is the common achievement of many experts from around the world. Their background as clinicians, physicists, biologists, computer scientists, engineers, or health economists reflects the highly interdisciplinary character of the field of IBT. All participants want to share their expertise with those who need to know more about this still novel radiation therapy option, with those who consider to do research in IBT, with the interested public, and with patients and their relatives who might want to learn about the background of this treatment modality and the clinical experience gained.

I am very much indebted to all the contributors of this book. It has been a great pleasure to be part of this international community of motivated and dedicated scientists.

I am also grateful to the Forschungszentrum Jülich, in particular to Sebastian Schmidt and Georg Büldt, for constant support and the permission to edit this book and to Claus Ascheron of Springer Publishing for endorsing this publication.

My sincere apologies go to all those whom I was pushing too hard to meet one or the other deadline.

Jülich  
October 2011

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Ion Beam Therapy

Fundamentals, Technology, Clinical Applications

Linz, U. (Ed.)

2012, XXXV, 729 p., Hardcover

ISBN: 978-3-642-21413-4