

# Preface

In the context of cancer treatment, radiotherapy plays an important role as more than 50% of cancer patients receive radiotherapy as part of multimodal treatment of their disease. Radiotherapy can be delivered percutaneously, interventionally e.g., as brachytherapy or during surgery as intraoperative radiotherapy (IORT). IORT is increasingly used for different entities as it delivers targeted radiotherapy to the tumor bed immediately during surgery. In the early 20<sup>th</sup> century the first reported IORT was delivered in a patient with endometrial cancer. Later a series of IORT was reported from Japan, where a <sup>60</sup>Co source was used to provide IORT. Nowadays, there are mainly three options to provide IORT:

- (I) IORT with low-energy X-rays (LEX-IORT);
- (II) IORT with electron beams (IOERT);
- (III) IORT with high-dose rate brachytherapy (HDR-IORT, e.g., using <sup>192</sup>Ir or <sup>60</sup>CoC).

As IORT is a truly interdisciplinary treatment modality, where radiation oncologists and medical physicists work hand in hand with surgeons, it highly facilitates the idea of a multimodal, personalized and targeted cancer treatment with low toxicity rates. To achieve best results using IORT an understanding of physics, biological effects, treatment possibilities and limitations are essential.

In this special issue we include articles introducing different treatment options for IORT and articles regarding basic research including radiobiology, immunology, physics and biology.

IORT is different from usual fractionated radiotherapy with photons or electrons. To provide the best treatment to the patient one should be familiar with physics and radiobiological effects. In a review written by Carsten Herskind recent radiobiological knowledge and thoughts maintain the basic understanding of high dose radiotherapy of tumor cells and normal tissue. Pedro Lara *et al.* give us a very comprehensive delineation of systemic effects of IORT, especially immune effects of high dose treatments. Luigi Minafra and Valentina Bravata from Cefalù, Italy provide their overview from biology on cell and molecular response to IORT focusing in high dose radiotherapy as is delivered for IORT. In addition Simon Lam *et al.* and Dounia Bouzid *et al.* provide new aspects regarding dosimetric characteristics and other physical aspects of new applicators like the flat and surface applicators for skin and other flat applications and the needle applicator for KypHo-IORT for LEX-IORT. Marco Krenkli *et al.* share the results from the ISIOR pooled analysis of IOERT and LEX-IORT to give us an overview of indications and numbers of treated cases with IORT in general in the last years in Europe and Petra Miglierini *et al.* present their first experiences with KypHo-IORT in Brest, France.

The most experience in IORT is still published for breast cancer. Recent articles showed possibilities and limitations of IORT as an accelerated partial breast radiotherapy delivered as IOERT or LEX-IORT. Additionally, IORT in general may serve as an advanced boost during breast conserving surgery with adjuvant whole breast radiotherapy. In this issue first reports are available from Geneva, Switzerland by Vincent Vinh-Hung *et al.* and from Brest, France by Petra Miglierini *et al.* using LEX-IORT. From Cologne, Wolfram Malter describes different opportunities for reconstruction after LEX-IORT. With the review from the European Institute of Oncology in Milan a broad experience of IOERT for breast cancer is summarized by Roberto Orecchia *et al.* and shows results from more than a decade using electrons for IORT.

New perspectives for IORT are given by Frank Giordano *et al.* They describe the possibilities and limitations of LEX-IORT for glioblastoma and present a new concept for a pioneer trial.

To continue this topic in the coming issues of *Translational Cancer Research*, Marc Piroth and Michael Eble is invited to review the applications of IOERT; Jayant Vaidya to update TARGIT; and Wojcek Polkowski *et al.* to show their results of a series of LEX-IORT in patients with recurrent rectal cancers.

In summary, after a dormancy of several decades after the first IORT report early in the 20<sup>th</sup> century and a period when IORT was offered only in several specialized centers worldwide, IORT has been increasingly used for the treatment of cancer patients worldwide in several hundred cancer centers during the last 10-15 years with breast cancer being now by far the most common disease entity.

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