Cancer is one of the leading causes of death worldwide. According to the World Health Organization (WHO), there are about 13 million new cases per year, and 8 million deaths annually, which account for 13% of all human deaths. This mortality rate has been projected to rise to 12 million by 2030 (2011 Global cancer statistics, CA: A Cancer Journal for Clinicians, Vol 62(2) p69-90, March/April 2011). The three major modalities for cancer treatments are surgery, chemotherapy, and radiotherapy. Since its discovery over the 110 years ago, the field of radiation therapy has progressed significantly and played an important role in cancer treatment. Like other fields in medicine, radiation therapy has depended most heavily on technology and science for its advancement. There have been continuing developments in discovery of various sources and different modes of radiation in laboratory, and transitioned scientific research into clinical practice. Charged particles with their favorable depth of dose distribution are ideal for treating tumors located inside the body. Despite its discovery and theoretical advantages were almost 60 years ago, the clinical implementation of charged particle beam therapy has been slow due to the cost and size requirement, and its use has been limited to physics research laboratories until the last few decades. The cooperation among research laboratories, academic medical centers, and private industries has improved the technology, affordability, and ease of implementation. There has been an evolution of charged particle beam therapy over the three frontiers: technology, radiobiology and clinical outcomes. At the time of this writing, there have been more than 100,000 patients treated with charged particle beam therapy worldwide at more than 40 centers. There are several dozen centers are currently being developed. These numbers are very small (<5%) comparing to the number of photon treatment centers, and only a small fraction of cancer patients will benefit from charged particle beam therapy. With all the potential advancements from physics and radiobiology, the field of charged particle beam therapy is still facing many challenges and is far from reaching its full capacity and application, especially how to improve patients’ survival and quality of life as well as to be cost effective.

To address the importance of charged particle beam therapy, the editorial teams of Translational Cancer Research (TCR) and Journal of Gastroenterology Oncology journals have been making great efforts to collect the articles that were published in these two journals into these proceeding to go over this special topic of charged particle beam therapy. Contributors are experts from particle beam centers around the world. These peer-reviewed articles present the past experience, current status, and future directions for charged particle beam therapy. We divide the articles into two categories: Clinical and Physics/Biology. Several articles in the Physics/Biology, such as nanotechnology, represent the future trend of radiation therapy, not just particle beam therapy alone. We hope that this collection of articles will help clinicians, scientists, healthcare practitioners, and trainees to better understanding and appreciation of this new field with all the potentials and challenges. All technological challenges for particle beam therapy are similar to other radiation techniques, but they are at a greater magnitude and consequence. The history of radiation therapy has consistently showed that collaboration of clinicians, scientist, researchers, engineers and technology providers (vendors) has and can overcome lots of these challenges. This can be summarized by a quote from Theodore N Vail: “Real difficulties can be overcome, it is only the imaginary ones that are unconquerable”.

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