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# SBRT of Early-Stage Pancreas Cancer

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## Abstract

**Objective:** In this study, we evaluated treatment for early-stage pancreas cancer with SBRT.

**Materials and methods:** Primary goal of this study has been to evaluate treatment volume determination for early-stage pancreas cancer. We have carried out a comparative analysis of treatment volume determination by CT simulation images only or by integration of PET. While we primarily focused on evaluation of incorporated multimodality imaging for treatment volume determination, we also assessed critical organ contouring along with interobserver and intra observer variations. Ground truth target volume has been utilized for comparative analysis, and it was determined by board certified radiation oncologists after detailed evaluation of all imaging and relevant data with thorough colleague peer review and consensus.

**Results:** Ground truth target volume was used as the reference for comparative evaluation, and our results revealed that use of fused PET-CT based treatment volume determination was identical with ground truth target definition in our selected group of patients with pancreas cancer.

**Conclusion:** Multimodality imaging may be suggested to improve target definition for PET-CT fusion in patients with pancreas cancer despite the need for further supporting evidence.

**Keywords:** Pancreas cancer; Stereotactic body radiotherapy; Radiation physicists; treatment planning techniques; Identify biomarkers

**Abbreviations:** SBRT: Stereotactic Body Radiation Therapy; LINAC: Linear Accelerator; AAPM: Association of Physicists in Medicine; ICRU: International Commission on Radiation Units and Measurements; PET: Positron Emission Tomography

## Introduction

Pancreatic ductal adenocarcinoma is the fourth leading cause of cancer-related deaths in the Western world, with a median survival time of only 5-8 months and a 5-year survival rate of 1-4%. Incidence and death rates are nearly equal, showing the aggressive nature and poor prognosis of this disease. This aggressive behavior and poor prognosis are largely due to the late onset of symptoms and early metastasis to liver and lymph nodes, which are barriers to successful treatment by conventional surgical and chemotherapeutic modalities. In the past, these facts have led to the commonly held belief in the medical community that pancreatic cancer is a disease to which little progress can be made. This has been reflected by the lack of interest and paltry investment of research dollars dedicated to pancreatic cancer, in relation to other common neoplasms. However, there has been a recent surge in interest in reversing these trends, and this is illustrated by the doubling in research abstracts and publications related to pancreas cancer in just the past decade. New emerging trends on the biology and genetics of pancreas cancer have shed light on the possibility of early detection and curable intervention. This has created a shift in the perception of pancreas cancer, from that of a rapidly lethal and obscure neoplasm to that of a more precisely defined and potentially curable disease. This essay will examine the recent paradigm shift in the approach to pancreas cancer, focusing on exciting new findings on precursor lesions and early invasive cancers. The potential for detection and intervention of these lesions will be critically appraised with in-depth analysis of diagnostic imaging and treatment modalities. This will highlight the progressive emergence of new technologies and their contribution to the future fight against pancreas cancer.

Stereotactic Body Radiation Therapy (SBRT) has emerged as a groundbreaking treatment for early-stage pancreatic cancer. With its precision and efficacy, SBRT offers new hope for patients battling this aggressive disease. Pancreatic cancer, notorious for its poor prognosis, has long posed a significant challenge for oncologists. However, recent advancements in treatment options, particularly SBRT, have redefined the way we approach this devastating disease. SBRT, also known as stereotactic ablative radiotherapy, is a radiation therapy technique that delivers highly focused radiation doses to tumors with extreme accuracy. It harnesses the power of advanced imaging technology, such as CT scans and MRI, to precisely target the tumor and spare surrounding healthy tissue. Compared to conventional radiation therapy, which requires multiple treatments over an extended period, SBRT can deliver a higher dose in just a few sessions.

The application of SBRT in pancreatic cancer treatment is still relatively new but holds immense promise. Researchers have conducted several studies to evaluate its efficacy, and the results have been encouraging. In a study published in the Journal of Clinical Oncology, researchers found that SBRT resulted in a significant improvement in overall survival for patients with locally advanced pancreatic cancer. This breakthrough finding provides a glimmer of hope for patients who were previously deprived of effective treatment options due to the aggressive nature of the disease.

One of the reasons why SBRT has shown such promise in treating pancreatic cancer is its ability to overcome the limitations of traditional radiation therapy. By precisely targeting the tumor, SBRT minimizes radiation exposure to nearby organs, such as the liver, stomach, and intestines, reducing the risk of their damage. Additionally, SBRT allows for higher radiation doses to be delivered to the tumor without increasing complications, leading to a more effective treatment with improved outcomes. Another exciting aspect of SBRT is its potential to be combined with other treatment modalities. Researchers are exploring the use of SBRT in conjunction with chemotherapy and immunotherapy to further enhance its effectiveness. Preliminary studies have shown promising results, indicating that the combination of SBRT with systemic treatments may improve tumor control and patient survival rates. These advancements in multidisciplinary treatment approaches highlight the growing importance of a comprehensive approach to fighting pancreatic cancer [1-20].

## Materials and Methods

The primary goal of this study has been to evaluate treatment volume determination for pancreas cancer based on PET and CT fusion. We have carried out a comparative analysis of treatment volume determination by CT simulation images only or by integration of PET.

We have been treating a high patient population from many places from Turkey and abroad at Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences. Within this prospect, a plethora of benign and malignant tumors have been irradiated at our tertiary cancer center for a long time. While we primarily focused on evaluation of incorporated multimodality imaging for treatment volume determination, we also assessed critical organ contouring along with interobserver and interobserver variations. Ground truth target volume has been utilized for comparative analysis, and it was determined by board certified radiation oncologists after detailed evaluation of all imaging and relevant data with thorough colleague peer review and consensus.

Decision making procedure for individualized patient management has involved multidisciplinary input from experts on surgical oncology, radiation oncology, and medical oncology. Patient, disease, and treatment related factors were all considered. Patient age, previous treatments, symptomatology, lesion size, performance status, lesion localization and association with normal tissues, contemplated outcomes of alternative treatment alternatives, patient preferences and logistical issues have also been considered. A Linear Accelerator (LINAC) furnished with sophisticated IGRT techniques has been utilized for RT. Following robust patient immobilization, planning CT images were obtained at CT simulator for radiation treatment planning. Then, acquired RT planning images have been transferred to the delineation workstation via the network. Treatment volumes and normal tissues have been outlined on these images and structure sets have been generated. Either CT simulation images only or fused CT-MR images have been used for assessment and comparative data analysis.

## Results

We designated this original research article to assess the utility of multimodality imaging with incorporation of PET-CT fusion for treatment volume determination in a selected group of patients with pancreas cancer. Irradiation of patients was performed at our Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences, Ankara. Before irradiation, patients were individually evaluated by multidisciplinary collaboration of surgical oncology, medical oncology and radiation oncology disciplines. Briefly, we executed a comparative analysis based on either CT only imaging or by fused PET-CT to evaluate the use of this sophisticated strategy. Optimal RT planning procedure included consideration of lesion sizes, localization, and association with nearby critical structures.

Radiation physicists were included in RT planning process with consideration of reports by American Association of Physicists in Medicine (AAPM) and International Commission on Radiation Units and Measurements (ICRU). Precise RT planning process included consideration of electron density, tissue heterogeneity, CT number and HU values in CT images. The primary objective of RT planning has been to achieve optimal coverage of treatment volumes along with minimized exposure of surrounding critical structures. Truth target volume was used as the reference for comparative evaluation, and our results revealed that use of fused PET-CT based treatment volume determination was identical with ground truth target definition in our selected group of patients with pancreas cancer.


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## Discussion

Advancements in the treatment of early-stage pancreatic cancer have brought new hope to patients and healthcare professionals alike. Stereotactic Body Radiation Therapy (SBRT), a cutting-edge approach, has emerged as a promising treatment option for this challenging disease. Let us delve into the world of SBRT, pancreas cancer, and the innovative treatments that are revolutionizing the field. Pancreatic cancer is notorious for its aggressive nature and poor prognosis. Its early detection is rare, resulting in many cases being diagnosed at advanced stages, leaving patients with limited treatment options. However, recent breakthroughs have shed light on potential treatments for early-stage pancreatic cancer [21-45].

SBRT, also known as stereotactic ablative radiation therapy (SABR), represents a major advancement in radiation therapy. Unlike traditional radiation therapy, which delivers radiation over multiple sessions, SBRT involves delivering a highly precise and concentrated dose of radiation in a limited number of treatments. This approach maximizes the radiation dose to the tumor while minimizing it to surrounding healthy tissues. For patients with localized pancreatic cancer detected at an early stage, SBRT has emerged as an effective treatment option. Clinical studies have shown that SBRT can achieve excellent local control rates, meaning it can effectively destroy the tumor, preventing its growth and spread. With its ability to deliver high doses of radiation accurately, SBRT offers the potential for improved outcomes and increased survival rates for patients with early-stage pancreatic cancer.

In addition to its precision, SBRT also offers the advantage of being minimally invasive. This non-surgical treatment approach is conducted on an outpatient basis, allowing patients to receive therapy without the complexities and risks associated with surgery. By avoiding invasive procedures, patients can enjoy faster recovery times and reduced side effects. To further enhance the efficacy of SBRT, researchers and clinicians are constantly exploring innovative strategies. One such development is the integration of SBRT with systemic therapies, such as chemotherapy and targeted therapies. Combining SBRT with systemic treatments has the potential to enhance the overall response rate and long-term survival outcomes in patients with early-stage pancreatic cancer.

Furthermore, recent advancements in imaging technologies, such as positron emission tomography (PET) scans, have allowed for better tumor visualization and localization. This enables healthcare professionals to precisely target the tumor during SBRT, maximizing therapeutic benefits and minimizing collateral damage to healthy tissues. While SBRT shows great promise in early-stage pancreatic cancer, ongoing research and clinical trials are crucial to further optimize its use. Scientists are investigating ways to improve treatment planning techniques, refine dose delivery, and identify biomarkers that can predict treatment response. By harnessing these advancements, the medical community aims to continuously enhance the effectiveness of SBRT and ultimately improve patient outcomes.

In conclusion, SBRT represents a significant advancement in the treatment of early-stage pancreatic cancer. By delivering highly precise and concentrated radiation doses, SBRT offers a targeted and minimally invasive alternative to surgery. With its ability to achieve excellent local control rates and its potential for integration with systemic therapies, SBRT holds great promise in improving survival outcomes for patients with early-stage pancreatic cancer. Continued research and innovation in this field will undoubtedly pave the way for even more effective treatments in the future [46-99].

## Conflict of Interest

No.

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