

Radiation Oncology—New Approaches in Squamous Cell Cancer of the Head and Neck



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KEYWORDS

- Squamous cancer • Head and neck • Intensity modulated radiation therapy
- Radiation planning • Adaptive replanning • Image guided

KEY POINTS

- Changes in the use and implementation of multiple types of imaging can lead to improvements in the targeting of radiation therapy for head and neck cancers.
- Therapeutic radiation for head and neck cancers is improving based on the use of image guidance and different techniques for treatment delivery.
- The unique biology of human papilloma virus (HPV)-related cancers opens up the possibility of delivering less radiation to less tissue while maintaining efficacy.

INTRODUCTION

The field of radiation therapy for squamous cell cancer of the head and neck (SCCHN) has been transformed over the past decade, but the basic elements of radiotherapy remain the same: determining the appropriate dose to deliver, accurately identifying the targets, and delivering treatment with minimal normal tissue toxicity. The current standard of care, intensity modulated radiation therapy (IMRT), delivers improved tumor doses compared with the historical 3-field/3-dimensional conformal approaches, which were both effective in treating SCCHN. Current studies assessing the efficacy of IMRT demonstrate excellent outcomes,^{1–3} while acknowledging a contribution from the changing nature of oropharynx cancers and the use of retrospective data. Much of the benefit derived from IMRT has been in the area of normal tissue sparing. The treating physician exercises substantial control over where the dose is (and is not) directed; thus IMRT has led to significant improvements in obtaining a differential

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Hematol Oncol Clin N Am 29 (2015) 1093–1106

<http://dx.doi.org/10.1016/j.hoc.2015.07.008>

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between the doses delivered to the tumor related targets and normal tissue structures. These improvements were first clearly demonstrated in nasopharynx cancer where, because of anatomic considerations, the benefits are potentially the most significant. Results were derived from a combination of phase 2, 3, and retrospective studies.⁴⁻⁷ A phase 3 study that included oropharynx and hypopharynx compared IMRT and lateral opposed fields using 3-dimensional conformal methods and demonstrated similar results.⁸ For these sites, there is also a significant body of retrospective data highlighting the excellent normal tissue outcomes resulting from IMRT-based improved dose distributions.^{9,10} In order to achieve these distributions, one must precisely determine which structures need to be treated. This determination requires optimal imaging data and also requires a detailed knowledge of the disease behavior. The imaging component will be addressed in this article, while the second item emphasizes the importance of treatment at a high-volume center, which was demonstrated for 3-field treatment¹¹; IMRT potentially increases the benefit expected from the expertise of the individual practitioner. The concept used to describe the balance between tumor control and normal tissue effects is the therapeutic ratio (TR), and improving the TR has been a longstanding goal of radiation therapy. Further improvements in TR have taken on increased importance, as it is known that there are myriad effective treatments for SCCHN occurring in a younger and healthier population.

Overview

Multiple pathways to improving the TR for radiation therapy SCCHN patients will be addressed in this article. Advances in imaging allow the physician to more accurately identify tumor and adjacent tissues that are at risk of containing microscopic disease. The approaches addressed here include improvements of existing technologies (eg, MRI, positron emission tomography [PET]) as well as the use of other modalities. A second approach for improving TR is to improve the methods used for delivering radiation to the patient. The topics included in this paradigm are modifying how standard IMRT—photon based—is given, as well as the use of proton therapy. Underlying the designation of appropriate targets is the understanding of the disease being treated and how that disease may be changing. Specifically, there is the ever-present influence of HPV-related disease and the questions it raises in radiation therapy, such as how much radiation is necessary and how big a volume needs to be treated.

This article focuses on radiation therapy alone and cannot address the many important relationships with surgery and systemic therapy.

IMAGING ADVANCES

As head and neck radiation treatments have become more targeted, accurate target delineation has become more critical to avoid missing tumor and identifying areas at highest risk for microscopic tumor spread.^{12,13} Additionally, the steep dose gradients and high doses delivered in close proximity to critical organs such as the spinal cord and brainstem necessitate millimeter-level accuracy in the definition of these normal structures. Thus, it is crucial to incorporate all anatomic information available during the radiation treatment-planning process. In many cases, the clinical examination is the cornerstone of this process; however, diagnostic imaging modalities such as computed tomography (CT), PET, and MRI provide complimentary information and have been increasingly incorporated into clinical practice.¹⁴

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