Clinical Use of a Novel Balloon Based Esophageal Brachytherapy Applicator

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Purpose: High dose rate endoesophageal brachytherapy is an option in the management of primary and recurrent esophageal cancer in inoperable patients. In a review of a series of patients treated at our institution (Folkert et al Brachytherapy 2013) we found HDR brachytherapy was safe and well tolerated, but was associated with a high rate of local recurrence. To overcome the limitation of surface dose, and enable a dose escalation study we designed a novel balloon based applicator (Cohen and Goodman, Brachytherapy 2015). Here, we report on the initial clinical use of this applicator.

Materials and Methods: The esophageal (E) applicator (Ancer Medical, Nashua, NH), a five-balloon self centering applicator with one treatment catheter, was used. Under general anesthesia and with fluoroscopic guidance, the applicator was inserted into the esophagus over a guidewire into the treatment position, and centered by inflating the five balloons. Visualization of the applicator was achieved using the integrated X-ray markers, and 10% CT contrast in the balloons. A CT scan was obtained for planning, the target and surrounding healthy esophagus were contoured, the source channel was traced, and a treatment plan optimization was performed to deliver 15 Gy in 3 fractions (BrachyVision, Varian Medical systems, Charlottesville VA). After review and approval of the plan, the applicator positioning was verified, and the initial treatment was delivered using a GammaMed-Plus HDR afterloader. Anesthesia was reversed at the completion of treatment. For the subsequent two weekly treatments, the original CT plan was used, and the applicator was inserted under fluoroscopic guidance. Positioning of the applicator can be verified by matching the treatment length to fluoroscopically placed surface markers, and by measuring the insertion distance from the incisors using integrated insertion markers. In this case, applicator positioning was verified with respect to a pre-implanted fiducial marker. After confirmation of applicator positioning, the treatments were delivered.

Results: The applicator geometry enabled good coverage of the target volume (V100 = 95%, D90 = 108%, and V150 = 44%) while keeping the surface dose within tolerance limits (D0.3cc < 11Gy) and sparing uninvolved esophageal tissue (D0.3cc = 92%, D1cc = 75%, and D2cc = 58%). Good applicator re-positioning was achieved for all treatments. The applicator shown in the figure below (panels A, B) incorporates X-ray markers to aid with positioning. CT based planning was performed (panels C-F). Because of the non uniform spacing between the source axis and tissue surface, optimization results in non uniform dwell-times (panel E). Fluoroscopic image of the applicator placement is also shown (panel G).

Conclusions: This is the first report on using the E applicator in patients. The improved treatment geometry achieved with this applicator provides encouraging feedback for continuation with dose escalation in these patients.