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Volume-based pulsed-dose-rate brachytherapy boosting concurrent chemoradiation as a definitive treatment modality in cervical cancer

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ABSTRACT

PURPOSE: To report the treatment outcomes and treatment-induced adverse events (AEs) of concomitant chemoradiotherapy boosted with pulsed-dose-rate brachytherapy using volume-based two-dimensional planning in patients with cervical cancer.

PATIENTS AND METHODS: After obtaining the institutional review board approval, patients with FIGO Stages IB to IIIB cervical cancer, treated from January 2006 to December 2008 consecutively, were included. Volume-based planning was used and entailed defining an envelope around the tumor on a two-dimensional image and prescribing the dose to this envelope and reporting the dose of the isodose of 60 Gy. Patients and tumor characteristics, dosimetric parameters, AEs and treatment outcomes, local control rate, distant metastases rate, progression-free survival, and overall survival are reported.

RESULTS: The study included 95 patients; the median age is 50 years. The median tumor size is 50 cc (range, 25–78 cc). Median brachytherapy dose delivered to the envelope is 20 Gy (range, 15–35 Gy), and median volume encompassed by 60 Gy isodose curve is 137 cc (range, 26–365 cc). The 3-year overall survival, progression-free survival, local control rate, and distant metastases rate were 83.8%, 72.4%, 84.8%, and 15.4%, respectively. Gastrointestinal and genitourinary Grade 3 and 4 acute AEs were reported in 11.6% and 3.3% and chronic Grade 3 and 4 AEs were reported in 3.2% and 4.2% of all patients, respectively.

CONCLUSIONS: Chemoradiotherapy followed by pulsed-dose-rate brachytherapy boost is effective and tolerable treatment modality for locally confined cervical cancer.

Keywords: Pulsed-dose-rate; Brachytherapy; Cervix

Introduction

Concurrent chemoradiotherapy (CRT) is currently the standard definitive treatment modality for local-regionally confined cervical cancer based on a number of randomized clinical trials reported in 1999; it is associated with a significant toxicity profile mainly to bladder, rectum, and bowel (1–5).

Not until recently, modernization and technological advancement of brachytherapy (BT) took place in the clinical practice through the wide adoption and implementation of the image-guided BT (IGBT) based on MRI planning that was introduced by the recommendations of the working group for gynecologic BT of the Groupe Européen de Curiethérapie/European Society for Therapeutic Radiology and Oncology (6, 7). Frequent reports were followed to prove feasibility, tolerance, and efficacy of this new approach. Most of these reports used high-dose-rate (HDR) BT (8–11).

The main technical advancement in IGBT is the introduction of dose–volume histograms for BT treatment planning to tumor as well as organs at risk (OAR) (6, 7). This volume-based treatment planning and dose prescription was proved in a number of subsequent reports to provide better tumor coverage and lower radiation doses delivered to OAR compared with the two-dimensional (2D) treatment planning. For decades, radiation oncologists used to prescribe their BT dose to ICRU 38 report Point A with an

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ultimate goal of achieving 80–85 Gy at this point regardless of the actual tumor geometry (8–12).

Pulsed-dose-rate (PDR) BT is theoretically considered to hold some radiobiological advantages over HDR BT as each fraction comes before the complete repair of the sub-lethal cellular damage of the subsequent fraction; the tissue perceives the radiation as almost continuous, mimicking low-dose-rate (LDR) BT. Furthermore, PDR maintains the fine optimization of the dose distribution to the target volume (TV) and protects the personnel involved in the treatment from the risk of radiation exposure. Therefore, PDR holds the radiobiological advantages of LDR and the fine planning and radiation protection advantages of HDR (13, 14).

Most French radiation oncology centers favor LDR and relatively recently PDR, believing in the biologic advantages of LDR and PDR and the possibility of optimizing treatment plans by controlling the source stepping time in each dwell position (15, 16). In our institution, we used to have the tumor topography assembled on a 2D film where we draw an envelope that encompasses TV and prescribe BT dose to this envelope. We also used to report the dose to an isodose of 60 Gy that usually would encompass the envelope and report the volume encompassed by this isodose (Figs. 1 and 2). This study aimed to describe and report the treatment-induced adverse events (AEs) and treatment outcomes of CRT boosted by PDR BT using volume-based 2D planning in patients with locally advanced cervical cancer. This study reports the largest series of cancer cervix patients treated with this technique.

Patients and methods

This is a retrospective study that was approved by the institutional review board. Charts of patients with Stages IB to IIIB squamous cell carcinoma (SCC) of the cervix treated between January 2006 and December 2008 and

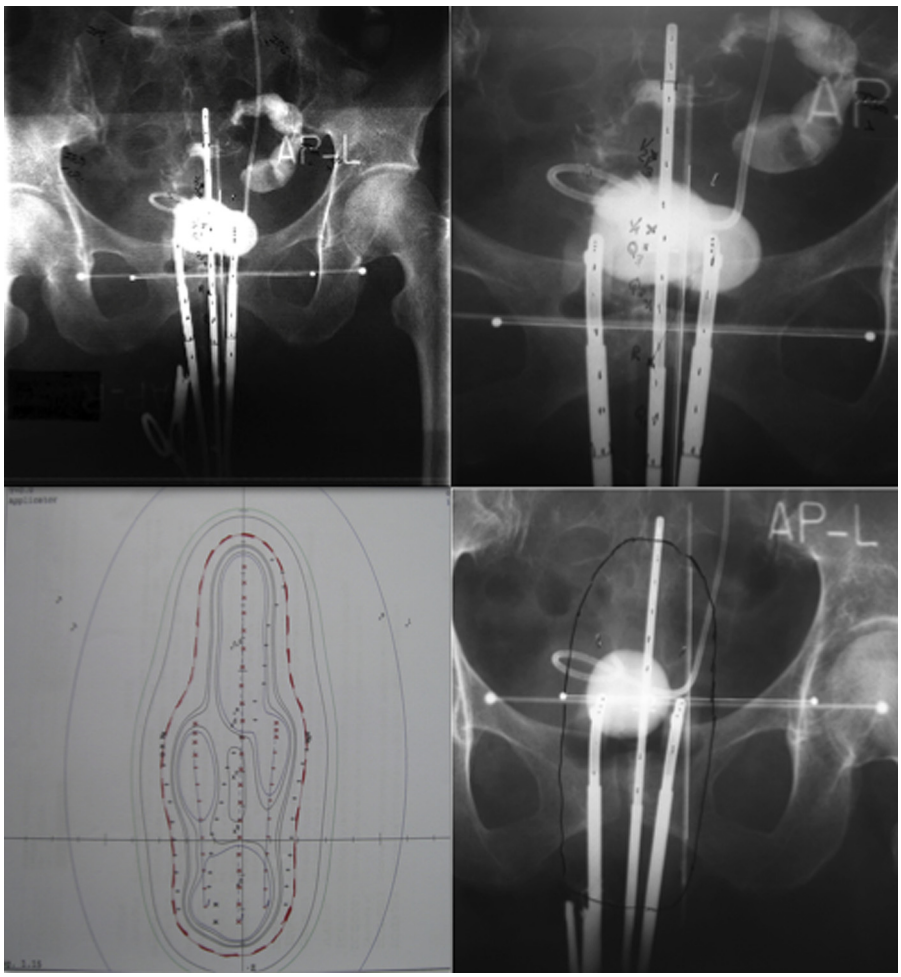

Fig. 1. A case of Stage IIIB squamous cell carcinoma of the cervix; initial tumor volume was 70 cc. An envelope is drawn around the TV and an isodose—in red—encompassed this envelope (127 cc). The patient received a 50 cGy pulse/h for 40 h delivering total of 20 Gy to the entire envelope. The reported max and mean rectal doses were 19.87 and 18.41 Gy, and the max and mean bladder doses were 19.75 and 17.67 Gy, respectively. The planning system and machine used is produced by Nucletron, an Elekta company (Elekta AB, Stockholm, Sweden). TV = target volume. (For interpretation of references to color in this figure legend, the reader is referred to the web version of this article.)