ELSEVIER

Brachytherapy ■ (2017) ■

BRACHYTHERAPY

Dosimetric analysis and preliminary clinical result of image-guided brachytherapy with or without hybrid technique for cervical cancer using VariSource titanium ring applicator with "Siriraj Ring Cap"

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ABSTRACT

PURPOSE: Titanium ring cap applicator (VariSource) was applied in treating cervical cancer patients by using image-guided brachytherapy (IGBT). However, its sizes appeared to be relatively large for most of our patients. Thus, we have developed a specific applicator "Siriraj Ring Cap," which is slightly smaller and more suitable for our patients. This study was to evaluate effectiveness of this equipment.

METHODS AND MATERIALS: Locally advanced cervical cancer patients were treated with external beam radiation therapy with or without concomitant chemotherapy. Siriraj Ring Cap was applied in all of the patients for at least one fraction. Dosimetric analysis was performed in each fraction of IGBT. Clinical outcomes of these patients were evaluated.

RESULTS: Twenty-nine patients with 117 dosimetric planning were evaluated between January and December of 2014. Siriraj Ring Cap was fit to all patients in this study. By using this applicator, radiation doses to the targets (D_{90} high-risk clinical target volume and D_{90} intermediate-risk clinical target volume) were higher in each fraction. There were no statistically differences of radiation doses to the bladder, rectum, sigmoid colon, and small bowel. Within 2-year followup, 3 patients (10.3%) developed locoregional recurrence. Two-year disease-free survival and overall survival were 75.9% and 89.7%, respectively. According to RTOG/EORTC complication criteria, Grade 1, 2, and 3 gastrointestinal complications were developed in 2 (6.9%), 4 (13.8%), and 1 (3.4%) patients, respectively. For genitourinary complications, 3 patients (10.3%) and 1 patient (3.4%) had Grades 1 and 2, respectively.

CONCLUSIONS: Siriraj Ring Cap is feasible for IGBT in cervical cancer patients with narrow vagina. Dosimetry and clinical outcomes were satisfactory by using our specific applicator.

Keywords: Image-guided brachytherapy; Cervical cancer; Ring applicator; Siriraj ring cap; Hybrid technique

Introduction

Radiotherapy, including external beam radiotherapy (EBRT) and brachytherapy (BT) with concurrent platinum-based chemotherapy, is the major treatment modality of locally advanced cervical cancer patients. Currently, BT techniques have been changed from two-dimensional to be three-dimensional brachytherapy (3DBT). 3DBT provides more precise radiation doses and offers satisfactory outcomes with less morbidities (1−3). The commercial titanium ring applicator (VariSource) (Fig. 1) has been used in our institute. However, it appeared that the applicator size is relatively large for our patients' vaginal canal. This led to patients' discomfort, inappropriate equipment position, and insufficient radiation doses to the targets. Hence, we have developed our specific equipment, Siriraj Ring Cap (Fig. 2), for our patients. This applicator is more suitable for our patients given a smaller diameter (3.5 cm). The purpose of this study is to evaluate the effectiveness of the equipment.

Received 2 April 2017; received in revised form 24 June 2017; accepted 5 July 2017.

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1538-4721/$ - see front matter
http://dx.doi.org/10.1016/j.brachy.2017.07.009

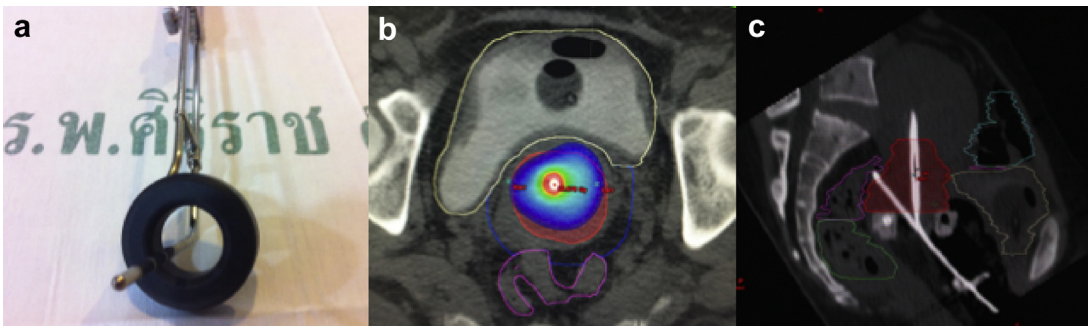

Fig. 1. (a) VariSource ring cap, (b) dose distribution using other applicator with insufficient radiation dose to the target, and (c) inappropriate needle implantation with VariSource ring cap.

Methods and materials

Patients

This study was approved by the Ethics Committee of the Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand (protocol number 116/2016). Treatment records of FIGO Stage I−IVA (4) cervical cancer patients treated in our hospital during 2014 were reviewed. All cervical cancer patients who received 3DBT with or without interstitial implantation, by using Siriraj Ring Cap for at least one treatment, were included in our study.

Patients characteristics (age, tumor size, tumor staging), followup time, and disease status were recorded. The following data of 3DBT were noted: radiation doses of each fraction and total doses, and equipment used for BT (Siriraj Ring Cap or other applicators). Also, external beam radiation therapy data, chemotherapy, and side effects of treatments including gastrointestinal (GI) and genitourinary (GU) complications were evaluated. The primary objective of this study is to compare radiation doses of each fraction and total doses between using Siriraj Ring Cap vs. other applicators such as fletcher suit or commercial ring applicator. The secondary outcomes are locoregional recurrences, survival, and morbidities. Late complications, which are defined as complications occurred later than 6 months after radiotherapy, were assessed. Severities of complications were classified according to RTOG/EORTC classification (5).

Treatments

Definite treatment consisted of 45−50 Gy EBRT delivered in 25−28 fractions with or without 6−10 Gy parametrial boost in 3−5 fractions. High-dose-rate (HDR) 3DBT was performed with 7 Gy per fraction, 4−5 fractions in total. Additionally, patients were treated with or without concomitant weekly cisplatin (40 mg/m^2) during EBRT. The whole pelvic radiotherapy was performed with a 3D conformal technique. MRI of the pelvis was performed at pretreatment and pre-BT sessions for all patients.

Regarding BT procedure, we contoured high-risk clinical target volume (HR-CTV), intermediate-risk clinical target volume (IR-CTV), and organs at risk (OARs) according to the Gynecologic GEC/ESTRO recommendations (1−3). CT and/or MRI were delivered for each BT planning. The CT protocol was contiguous slices of 2 mm and bladder filling at least 50 cc. The MRI protocol was three dimensional T2 weighted with para-axial according to cervix uteri axis, repetition time as 2000−5000 ms, and echo time as 90−120 ms with bladder filling at least 50 cc. The slices of both images should extend from at least 5 cm above the tip of the tandem to at least 5 cm below the bottom of the ischium. The cumulative dose of treatment (ERT and 3DBT) was at least 84 Gy equivalent dose (EQD2) to 90% of HR-CTV volume (D_{90} HR-CTV) using alpha/beta of 10. Dose to 90% of

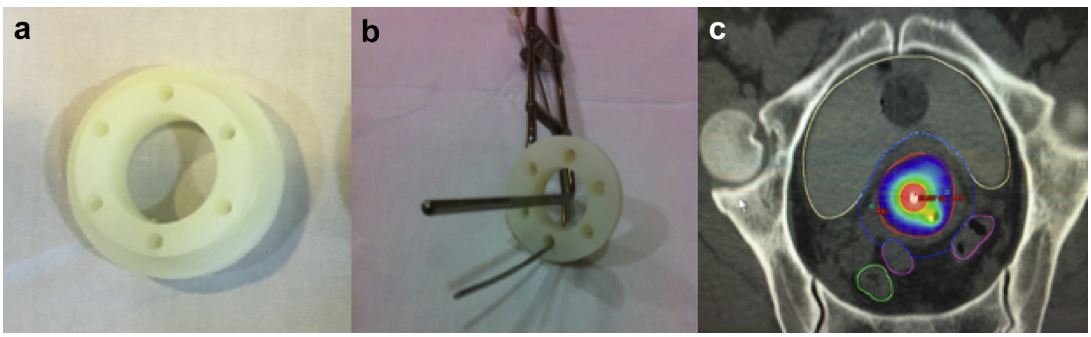

Fig. 2. (a) Siriraj Ring Cap, (b) needle implantation with VariSource ring cap, and (c) dose distribution using Siriraj Ring Cap for adequate radiation dose.