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Can Dynamic Conformal arc be an Option in Epidermoid Cervical Cancer Treatment?

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Abstract

Historically locally advanced cancer of the cervix has been treated with radiotherapy and brachytherapy and it was not until 1999 that the use of concurrent chemotherapy was formalized due to excellent results in terms of rate of overall and disease-free survival. Box technique in radiotherapy is the most widely known providing excellent results, with some variations as oblique fields, but greatly increasing irradiation potentially healthy tissue, leading to the higher proportion of own side effects of each treatment. Therefore present a radiant treatment planning mode Dynamic Conformal Arc for cervical carcinoma.Treatment with dynamic conformal arc achieves better conformation of tumor and area to be treated, avoiding unnecessary doses to organs at risk (OAR), compared to conventional four fields irradiation technique (box technique), further significantly reduces the treatment time.Dynamic Conformal Arc (DAT) technique in the pelvis reduces irradiation dose in the organs at risk, making a good coverage of the clinical area to be treated, further decreasing the side effects. It could be considered as an alternative to conventional treatment of 4 fields or to the impossibility of intensity modulated radiation therapy (IMRT).

Keywords: Dynamic; Conformal; Arc; Cérvix; Box; Technique, INCART, DAT

Introduction

Worldwide, cervical cancer is the fourth most common female malignancy in both incidence and mortality, resulting in approximately 527,600 new cases and 265,700 deaths annually [1,2]. Currently among the female population of Dominican Republic, cervical and breast cancer disputed the first and second place, statistics that resemble those seen in other developing countries in Latin America and the Caribbean. The high burden of cervical cancer in developing countries reflects the absence of cervical cancer prevention programs. The majority of the incident cases and deaths from cervical cancer, occur in developing countries, where resources for early detection and treatment are severely limited [3-5].

Cervical cancer and precancerous lesions behave as a sexually transmitted disease, especially associated with infection by the human papillomavirus (HPV), this being the causative agent of this disease in >99% of cases [6,7].

The definition of locally advanced cervical cancer, include patients with stage IB2 to IVA (Table 1). Surgery is not a therapeutic option for patients with stage IIB, III and IV due to a high proportion of positive margins and high risk factors for recurrence. External beam radiation therapy with chemotherapy plus brachytherapy has been, so far, the treatment of choice for patients with locally advanced cervical cancer [8-11].

Methods and Materials

Patient

Female patient 68 years old with a history of hypertension, who was referred to the National Cancer Institute Rosa Emilia Sánchez de Tavares (INCART) Radiation Oncology Center (CRO) for radiation treatment concurrent with chemotherapy.

The patient refered genital bleeding and pain, so go to doctor who performs studies including biopsy, which concluded: squamous cell carcinoma moderately differentiated, infiltrating, therefore requested CT pelvis with contrast, in which large mass cervicalwas evidenced, with extension to the uterine myometrium, associated with dilated endometrial cavity (with approximate dimensions 66mm anteroposterior diameter) with sero-hematic contained therein, with slight irregularity of the serosa of the cervix, with subtle attenuation peripheral fat; turn left evidence obturator lymph nodes in region.

Table 1: FIGO Staging 2009.

Stage	Description
I	The carcinoma is strictly confined to the cervix (extension to the uterine corpus should be disregarded).
IA	Invasive cancer identified only microscopically. (All gross lesions even with superficial invasion are Stage IB cancers.) Invasion is limited to measured stromal invasion with a maximum depth of 5 mm and no wider than 7 mm.
IA1	Measured invasion of stroma ≤ 3 mm in depth and ≤ 7 mm width.
IA2	Measured invasion of stroma N 3 mm and b 5 mm in depth and ≤ 7 mm width.
IB	Clinical lesions confined to the cervix, or preclinical lesions greater than stage IA.
IB1	Clinical lesions no greater than 4 cm in size.
IB2	Clinical lesions N 4 cm in size.
II	The carcinoma extends beyond the uterus, but has not extended onto the pelvic wall or to the lower third of vagina.
IIA	Involvement of up to the upper 2/3 of the vagina. No obvious parametrial involvement.
IIA1	Clinically visible lesion ≤ 4 cm
IIA2	Clinically visible lesion N 4 cm
IIB	Obvious parametrial involvement but not onto the pelvic sidewall.
III	The carcinoma has extended onto the pelvic sidewall. On rectal examination, there is no cancer free space between the tumor and pelvic sidewall. The tumor involves the lower third of the vagina. All cases of hydronephrosis or non-functioning kidney should be included unless they are known to be due to other causes.
IIIA	Involvement of the lower vagina but no extension onto pelvic sidewall.
IIIB	Extension onto the pelvic sidewall, or hydronephrosis/non-functioning kidney.
IV	The carcinoma has extended beyond the true pelvis or has clinically involved the mucosa of the bladder and/or rectum.
IVA	Spread to adjacent pelvic organs.
IVB	Spread to distant organs.

External beam radiation therapy was indicate and the treatment was performed in a Varian® Trilogy® linear accelerator, 120 multileaf colimator, making the target and OAR delimitation and planning in the Helios-Eclipse System® and treatment verification through portal vision and OBI image. The prescrition dose was 180 cGy/daily to 4500 cGy, then BOOST to parametria 200 cGy/daily until 1000 cGy. The complete doses was 5500 cGy, with posterior 3D brachytherapy.

Tumor Description

i. US transvaginal: cervical canal with voluminous mass 5.6cm x 6.8cm x 4.6cm.

ii. Cystoscopy: Protrusion of the posterior rectal wall without bladder invasion

iii. Rectosigmoidoscopy: a retroflection output and anal canal, broad-based Polymorphic injury is evident.

Pelvis CT and definition of the target volume and OAR

The patient was treated in the supine position, with support leg positioning to ensure reproducibility. The cervix, uterus, regional lymph nodes, bladder, rectum and sigmoid were defined [12,13]. We make treatment planning based on a CTV45.0_1.8 + 5mm margin and PTV45.0_1.8 + 5mm margin. Subsequently it was defined a PTV10.0_2.0, which was limited to the parametrium.

Settlement field

It has been proposed a technique of dynamic arcs (DAT) for its acronym in English: dynamic arc treatment, whose purpose is based on the PTV using multileaf collimation at all times when they are performing the angular displacements of the gantry (Figure 1).

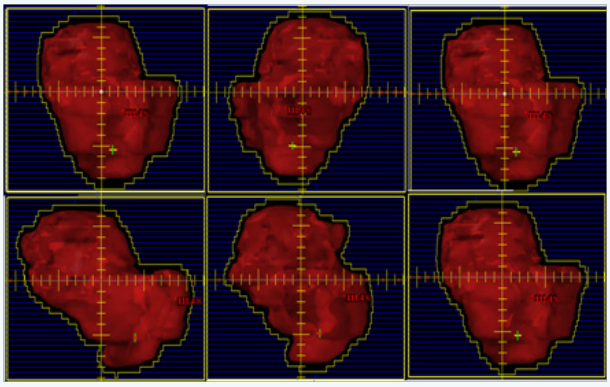

Figure 1: Beam Eye View six angles of the plan.

Therefore, to perform volume coverage planning have established two semi-arcs. The first arc with an angular displacement from 0° to 179° and the second arc of 179° to 359°. 100 control points were established for each 1.8 ° of displacement. Each checkpoint was assigned a weight of 0.0101.

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(Figure 2), the formation of the PTV was made with multileaf (Figure 3).

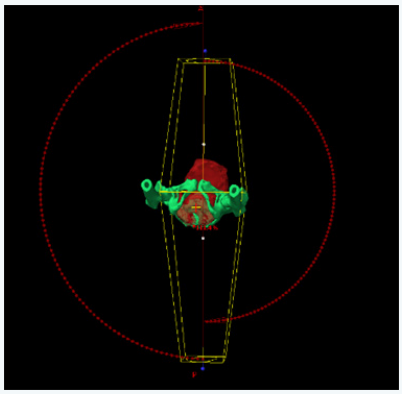

Figure 2: Proposed arches to cover PTV.

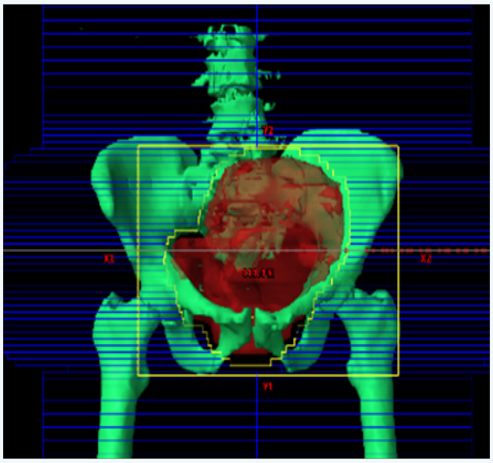

Figure 3: Multileaf PTV Conformation.

Patient Positioning

The patient was checked every 3 days using portals fields each other orthogonal 10x10 cm^2 images and OBI. The structure of the pelvis was matched to the anatomy of the pelvis of digital radiography rebuilt.

Discussion

The Dynamic Conformal Arc plan compared with the conventional technique of box has two important advantages, including: dose and time (Figure 4).

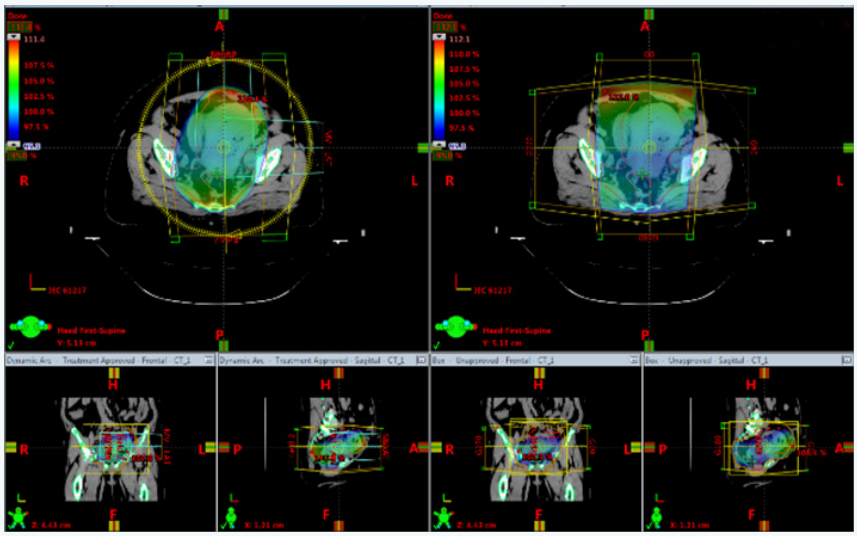

Figure 4: Comparison of dose distribution for the first phase with Dynamic Conformal Arc (Left) and four field technique (right). 95% isodose of the two schemes shown.

Dose

As shown in Figure 5 the 60% isodose technique box for tissue level reaches subcutaneous and obviously undesired dose to the patient, while for the DAT technique does not show the 60% dose in said area. Isodose reaching the subcutaneous tissue with DAT is 35%. Having a differential decrease of approximately 25% over the conventional field.

Furthermore, the conformity of dose PTV DAT technical box is smaller. The compliance rate for PTV box was 1.09 while for the DAT was 1.07.

Time

The total time for the each conventional fields was 2.02 minutes while for DAT it was 1.4 min total treatment.

Conclusion

Technological progress in radiation therapy in the last 30 years has many treatments available to patients that offer high-precision radiotherapy, with consequent reduced toxicity, increased doses to achieve greater tumor control and reduced irradiation time.

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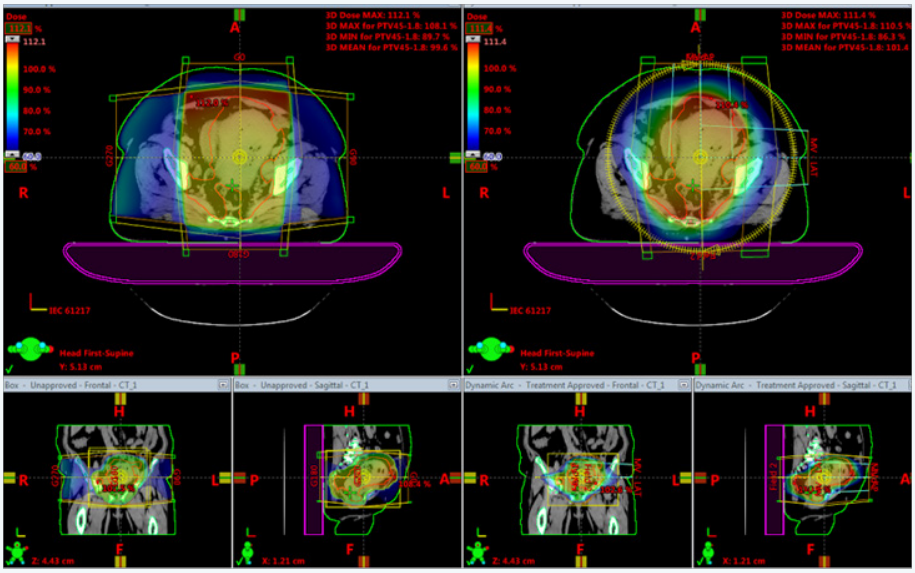

Figure 5: Comparison of dose distribution for the first phase with Dynamic Conformal Arc (right) and four field technique (left). 60% of the isodose shown in both plans to compare dose received in the subcutaneous tissue.

The use of Dynamic Conformal Arc (ACD) for treatment of cervical cancer allows considerable reduction of tissue outside PTV while improved volume coverage planning and time machine.

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