

Evaluation of Aortic Bifurcation in Cervical Cancer Patients

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ABSTRACT

Background: Cervical cancer is the second most common cancer in Indian women.

External Beam Radiotherapy (EBRT) and brachytherapy play an important role in the management of carcinoma cervix. EBRT treatment portals are designed to adequately cover the areas of gross and microscopic disease. The superior border of radiation portal is placed at L4-L5 intervertebral space to cover common iliac nodes, which lie caudal to the aortic bifurcation. The present study was done to evaluate the level of aortic bifurcation in relation to lumbar vertebrae in cervical cancer patients to reconsider the level of superior border of radiation portal while radiotherapy (RT) planning.

Methods: This retrospective study included cervical cancer patients who received EBRT from March 2019 to June 2020. Evaluation of level of aortic bifurcation was done on treatment planning system using computed tomography (CT) simulation images of the patients.

Results: We observed that aortic bifurcation occurred above the L4-L5 intervertebral space in 81.3% of the patients. The most common site of aortic bifurcation was at the level of L4 vertebral body i.e. in 64.1% of cases.

Conclusions: It is highly recommended to use CT based RT planning where the superior border of RT treatment portal should be placed considering individual patient anatomy. With conventional X-ray based planning, the superior border of RT portal may be shifted upwards at the level of L3-L4 intervertebral space to adequately cover the common iliac lymph node region. However, the benefit of extending the border must be weighed against the toxicities.

Keywords: Cervical cancer, aortic bifurcation, radiotherapy, treatment portal

INTRODUCTION

Cancer of cervix uteri ranks fourth for both incidence and mortality in women worldwide. [1] It is second most commonly diagnosed cancer in Indian women. [2]

Role of radiotherapy (RT) in the curative management of cervical cancer is well established. A combination of external beam radiotherapy (EBRT) and brachytherapy results in maximum survival benefit. EBRT treatment volume includes the uterus and cervix, vagina, parametrial tissue, and draining pelvic lymph nodes i.e. obturator nodes, internal iliac, external iliac, common iliac and presacral nodes. EBRT can be delivered using two-dimensional conventional radiotherapy (2D RT), three-dimensional conformal radiotherapy (3D CRT) or intensity modulated radiotherapy (IMRT). Conventional X-ray based planning uses bony landmarks to define the target volume. The traditional superior border of radiation portal for carcinoma of cervix is taken at the level of L4-L5 intervertebral space in order to cover the common iliac nodes. [3]

Pelvic blood vessels, with an appropriate margin, are used as a surrogate target for lymph nodes delineation. [4] CT simulation allows direct assessment of the pelvic vessels and adjacent para-aortic and pelvic nodes. [3] The common iliac nodes are located in proximity to the common iliac

artery and vein and therefore, lie caudal to the aortic bifurcation. [5] However, studies have shown that level of aortic bifurcation varies from individual to individual and may occur above L4- L5 intervertebral space. [6, 7]

In India, the patient load is very high in most centers. As compared to 3D RT/IMRT, 2D RT is preferred as conventional X-ray based planning is easy and consumes less time.

The present study was done to evaluate the level of aortic bifurcation in relation to lumbar vertebrae in cervical cancer patients to reconsider the level of superior border of radiation portal while RT planning.

MATERIALS AND METHODS

This retrospective observational study was conducted in the Department of Radiotherapy and Oncology, Dr. RPGMC, Kangra at Tanda, Himachal Pradesh, India. It included newly diagnosed, histopathologically proven patients of carcinoma cervix. Post-operative cases were excluded. The records of patients with cervical cancer who received EBRT from March 2019 to June 2020 in our hospital were reviewed.

For EBRT, either non-contrast or contrast enhanced images were acquired using 16 slice wide bore computed tomography (CT) simulator Optima 580RT (GE Healthcare Ltd). Sections were taken at 2.5mm interval. The images were then transferred to the treatment planning system (TPS). The contouring and RT planning was done on the Monaco TPS version 5.1.

For evaluation, aortic bifurcation was initially determined on axial sections and confirmed in the coronal sections using partial slice trackers and then correlated it with the corresponding vertebral level in sagittal section.

STATISTICAL METHODS

The data was collected, and entered using Microsoft Excel spreadsheet. The different categories of vertebral levels were tabulated and expressed in percentage (%).

RESULTS

Sixty four patients were analyzed for this study. Minimum age was 34 years and maximum was 88 and mean age of patients was 59.42 years (standard deviation = 10.65). The most common site of aortic bifurcation was at the level of L4 vertebral body i.e. in 64.1% (29/64) of cases. Aortic bifurcation occurred above the L4–L5 intervertebral space in 52 (81.3%) of the 64 patients. In 1.6% patients (1/64), abdominal aorta divided at the upper vertebral level of L3. The distribution of various levels of aortic bifurcation is described in Table 1.

Table 1: Level of bifurcation of abdominal aorta.

Aortic Bifurcation	n (%)
L3 upper	1 (1.6)
L3 lower	3 (4.7)
L3-L4 intervertebral space	7 (10.9)
L4 upper	13(20.3)
L4 mid	9 (14.1)
L4 lower	19 (29.7)
L4-L5 intervertebral space	10 (15.6)
L5 upper	2 (3.1)

DISCUSSION

In carcinoma cervix, the chances of pelvic lymph node metastases increase with stage advancement. [3] Hence, complete coverage of draining lymph nodal regions is essential.

Studies have been conducted suggesting deficiency in target volume. Beadle et al. [8] concluded that most regional recurrences after definite RT in the cervical cancer patients occur usually superior to radiation field. Rai et al. [9] assessed the patterns of recurrence in cervical cancer patients treated with pelvic nodal clinical target volume at L4–L5 junction instead of aortic bifurcation and found that maximum failures occurred in the common iliac region even when only clinically node negative (<10 mm on CT) patients were included.

The present study was done to evaluate the level of aortic bifurcation into right and left common iliac arteries with respect to lumbar vertebral level. In a retrospective study, Rai et al [9] reported aortic bifurcation above L4-L5 junction in 70.7% of patients. Mishra H et al [10] observed that the aortic bifurcation was

above L4-L5 junction in 74.4% of the cases. Ponni et al [11] found that the aortic bifurcation occurred above L4-L5 intervertebral space in 84.60% of the patients. The majority of patients (81.3%) had aortic bifurcation above L4-L5 intervertebral space in our study. However, Greer et al. [12] reported that the division of abdominal aorta takes place at the level of L4-L5 intervertebral space.

The major limitation of our study is small number of patients and its retrospective nature. A prospective study with large sample size is required to validate the results.

CONCLUSION

The bifurcation of abdominal aorta occurs above L4- L5 intervertebral space in majority of the patients. Hence, the conventional superior field border may be insufficient in adequately covering the common iliac group of lymph nodes.

In the centers using CT based radiation planning for treating carcinoma cervix patients, the superior border of RT treatment portal should be individualized (i.e. according to the level of aortic bifurcation as seen on CT images). In the centers using conventional X-ray based planning, the superior border of RT portal may be shifted upwards at the level of L3-L4 intervertebral space. The bowel toxicity can be reduced by using either corner lead shields or conformal blocks. However, the advantage of extending the field border needs to be weighed against increased treatment related toxicity.

Declarations

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Conflict of interest: None

Ethical approval: Institutional ethical committee

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