Oncology
and Radiotherapy ©
Vol.15 Iss.4:5-8 • Research Article

Comparison of pelvic lymph node coverage in conventional radiotherapy based on boney landmarks versus contouring radiotherapy in cervical cancer patients

Farnaz Amouzegar Hashemi[1], Mahsa Roozegari[1], Ebrahim Esmati[1], Maryam Garousi[2], Mojtaba Vand Rajabpour[1,3*]

[1]Radiation Oncology Research Centre (RORC), Cancer Institute, Tehran University of Medical Science, Tehran, Iran
[2]Department of Radiation Oncology, Iran University of Medical Science, Tehran, Iran
[3]Cancer Research Centre, Cancer Institute of Iran, Tehran University of Medical Science. Tehran, Iran

SUMMARY

Aim: We aimed to compare pelvic lymph nodes coverage in Digital Reconstructed Radiography (DRR) based on bony landmarks and 3D planning based on contouring in external beam radiation of cervical cancer patients.

Material and Methods: The study was carried out on 43 cervical cancer patients who were referred to Cancer Institute of Iran. We used RT Dose Plan software available in our department to define the treatment plan and field sizes. Images of patients were transported to RT dose plan software for planning. The Box treatment field (4 perpendicular fields) with or without additional brachytherapy was considered. The Dose Volume Histogram (DVH) and isodose curves were surveyed for acceptable tumour coverage. The study participants were assigned to two types of planning including planning based on anatomical markers (Conventional, DRR) and planning by considering the actual position of lymph nodes based on CT simulation images (CT).

Results: The mean age of participants was 51 years. In the AP/PA field, the mean difference of superior, right, and left lateral borders was -2.31, -0.29, and -0.029, respectively. On the other hand, the mean difference of inferior border was estimated 1.87. Further, in the lateral field, the mean difference of DDR and CT approaches for anterior and posterior borders was 0.89 and 0.164, respectively.

Conclusion: It seems CT simulation and use of contouring provide a better vision to pelvic lymph nodes and leads to wider coverage through reducing the possibility of ignoring treated areas. Nevertheless, more studies are required.

Key words: CT-simulation, DDR, radiotherapy, cervical neoplasm

Address for correspondence:

Keshavarz Boulevard, Imam khomeini Hospital, Cancer Research Center, Iran, email: Rajabpour.mojtaba@gmail.com

Word count: 4551 **Tables:** 05 **Figures:** 02 **References:** 14

Received: - 10 January, 2021

Accepted: - 10 March, 2021

Published: - 17 March, 2021

INTRODUCTION

Cervical cancer is one the most prevalent cancers in women and it is known as the major cause of death due to cancer in the US [1,2]. Lymph node involvement and the number of involved lymph nodes are two main factors which can predict prognosis of cervical cancer patients [3]. It has previously been shown that cancer recurrence is associated with the primary tumour size, lymph node involvement, margin resection, and depth of stromal involvement. Distant metastasis is also associated to pelvic local control particularly in patients who have iliac lymph node involvement [3].

EBRT plays a key role in the treatment of cervical cancer patients and it is known as ultimate treatment in patients with IB2-IVA stages. EBRT affects the entire pelvis including tumor gene, parameters, and at-risk lymph nodes [1,3,4]. EBRT treatment is mostly designed using X-ray or CT-scan. Conventional radiography based on bony landmarks using Digital Reconstructed Radiography (DRR) and treatment based on lymph nodes countering are two main approaches employed to design EBRT treatment plan. In the conventional approach, treatment fields include anterior/posterior and posterior-anterior fields, while in the countering approach we use CT-simulation and lymph node countering to determine treatment fields [4].

Several studies have reported that use of conventional approaches to address treatment field's leads to inadequate coverage or inappropriate dose distribution, and usage of sectional radiography has also increased concerns about inadequate coverage in the conventional approaches [5-7]. CT-simulation approach is the second method which can provide better pelvic coverage thereby providing a better treatment outcome in patients who suffer cervical cancer [7,8]. In the current study, we aimed to compare pelvic coverage between DDR conventional and treatment planning based on lymph node countering.

MATERIALS AND METHODS

Patients: Forty-three cervical cancer patients referring to

this center for concurrent chemo radiation between 2014 and 2016 were included in this study. Non-contrast CT images were available for all patients acquired from the treatment region.

Treatment planning

We used RT Dose Plan software available in our department to define the treatment plan and field sizes. Images of patients were transported to RT dose plan software for planning. The Box treatment field (4 perpendicular fields) with or without additional brachytherapy was considered. The Dose Volume Histogram (DVH) and isodose curves were examined for acceptable tumor coverage.

Two types of planning criteria were implemented for patients; i) planning based on anatomical markers (Conventional, DRR), and ii) by considering the actual position of lymph nodes based on CT simulation images (CT).

Conventional (DRR)

Initially, we planned the treatment strategy for all patients regarding the anatomical markers in the pelvic region as presented in Table 1. Digital Reconstructed Radiograph (DRR) image in RT-Dose plan software and 4-field Box of radiation were used.

Based on lymph nodes (CT)

The position of lymph nodes was defined according to the criteria of former studies of Chao et al [9], Taylor et al. [10], and RTOG [11]. For indicating the position of pelvic lymph nodes, overall margin of 14 mm was considered around pelvis vessels from aortic bifurcation to the end of obturator arteries. This 14 mm margin was selected to cover the lymph nodes and uncertainties in definition of PTV. The prescription dose to the PTV was within 95%-105% of total dose. Patients were treated by four fields (AP/PA,LL/RL) based on contouring with 50Gy in 25 fraction administered.

For all borders presented in Table 1, the difference between DRR and CT fields was indicated with the minus values in any direction meaning that the DRR field is smaller and vice versa.

Statistical analysis

We used mean and SD for continuous variables. To compare the mean difference between DRR and CT-simulation approaches, independent t-test was used. All statistical analyses were carried out using Stata software Ver. 14.0.

RESULTS

The study was performed on women aged 30-76. The mean age of study participants was 51 years. Table 2 reports the cancer stage of patients. We used the FIGO staging criteria for tumor classification. The mean difference between DDR and contouring approach at AP/PA field of superior border was -2.31 (± 2.06) with the negative sign signifying that DDR superior border was lower than in the contouring approach. However, we observed a higher value in the inferior border for DDR as compared to the contouring approach (mean difference (SD)=1.87 (± 0.61). We also compared right and left lateral borders and observed higher values for contouring approach compared to the conventional DDR (Mean difference=-0.29 (± 0.65) (Table 2).

Tab. 1. The margins and energy for conventional RT planning based on anatomical markers.

Field Margin	Anterior margin	Posterior margin	Right and Left margin	Superior margin	Inferior margin	Beam Energy
PA and AP	-	-	1.5 cm away from hip bone	L4-L5	Inferior of the obturator foramen	
Lateral (Right and left)	Anterior part of symphysis pubis	Posterior surface of the Sacrum	-	L4-L5	Inferior of the obturator foramen	

Tab. 2. Frequency of tumors according to FIGO staging criteria

Tumor stage	Number of patients
stage 1b	5
stage 2a	1
stage 2b	22
stage 3a	5
stage 3b	4
Stage 4a	6

Tab. 3. The difference between DRR and CT fields. mean± SD Zminimum, Maximum).

Field	Superior	Inferior	Right	Left	Anterior	Posterior
AP/PA	-2.31 ± 2.06 (-7.3, 2.1)	1.87 ± 0.61 (0, 3.2)	-0.29 ± 0.65 (-1.7, 1.4)	-0.29 ± 0.65 (-1.9,0.4)		
Left Lateral					0.98 ± 0.62(-3.2, 1.2)	1.64 ± 0.83 (0,3.5)

Further, anterior and posterior borders in the lateral field were compared between DRR and contouring approach. In the anterior border of the left lateral field, the mean difference between DRR and contouring approach was 0.98 (± 0.62), while for the posterior border it was estimated 1.64 (± 0.83) (Table 3). This summarizes the difference between DRR and CT planning protocol for all borders of 4 box fields, where the minus values are correlated to larger field based on CT images.

DISCUSSION

External radiotherapy treatment planning in cervical cancer is mostly based on two identified treatment approaches including Digital Reconstructed Radiography (DRR) and CT simulation. In the current study, we aimed to compare these two approaches in terms of covering pelvic lymph nodes. Here, we observed lower coverage in conventional DRR compared to the contouring approach at the superior, as well as right and left lateral borders of AP/PA field where the mean difference was reported -2.31, -0.29, and -0.29, respectively. On the other hand, in the anterior and posterior border of AP/PA field as well as inferior border of both AP/PA and lateral fields, the mean value was higher in DRR approach than in contouring radiotherapy. Pendlberg et al reported that 62% of patients needed change of pelvic fields in conventional radiotherapy. In accordance to our findings, Pendlberg et al. found that lateral margins in AP/PA field in conventional approach were not sufficient [12]. They suggested that consideration of 2.5 cm for pelvic lateral margins and 0.5 cm for the anterior margin of Symphysis Pubis could be a useful approach to cover 90.0% of lymph nodes [12]. Additionally, Zunino et al. and Bonin et al. observed incomplete coverage of lateral lymph nodes of external Iliac in the AP/PA fields in conventional radiotherapy compared to PTV, which are in line with our findings [6,13].

In the current study, the mean of inadequate distance in patients with inadequate margins in the superior lateral fields was -1.64 cm which was higher than the value reported from Finally et al and Zhang et al. studies [5,14]. In the current study, we performed contouring with estimating appropriate margins in order to reach PTV volume, while Zhang and Finally only performed pelvic artery contouring [5,14]. However, the reported inadequate coverage in the mentioned distances was higher in the current study in spite of using wider margins. In the current study, the proportion of patients who at least had one inadequate margin was estimated 88.4% which is lower than the values reported by Fianaly et al. (95.4%) and Zhang et al. (97.0%). The main reason to justify the observed difference is anatomic variations between different races and ethnicities [5,14].

According to our findings, proportion of V95% in conventional radiotherapy was 87.0%, while for the contouring approach it was estimated 99.9%. These findings are comparable to Gulia et al who reported 89.4% and 93.0% of V95% for conventional radiotherapy and contouring approach, respectively [4].

The main limitation of the current study was not applying intravenous contrast due to technical problems. Nevertheless, we used radiologist consultation to enhance the accuracy of vascular contouring. We did not assess the association between the uncovered areas and failure of pelvic treatment either.

CONCLUSION

In conclusion, it seems CT simulation and use of contouring provide a better vision to pelvic lymph nodes and leads to wider coverage through reducing the possibility of ignoring treated areas. Nevertheless, further studies are required.

REFERENCES

REFERENCES

1. Brady LW, Perez CA, Wazer DE. Perez & Brady's principles and practice of radiation oncology. 2013.
2. DeVita VT, Lawrence TS, Rosenberg SA. Rosenberg's cancer: principles & practice of oncology. 2008.
3. Marnitz S, Köhler C, Schneider A, Seiler F, Hinkelbein W. Interindividual variability of lymph drainages in patients with cervical cancer. Strahlenther Onkol. 2006;182:80-85.
4. Gulia A, Patel F, Rai B, Bansal A, Sharma SC. Conventional four field radiotherapy versus computed tomography-based treatment planning in cancer cervix: a dosimetric study. South Asian J cancer. 2013;2:132.
5. Finlay MH, Ackerman I, Tirona RG, Hamilton P, Barbera L, et al. Use of CT simulation for treatment of cervical cancer to assess the adequacy of lymph node coverage of conventional pelvic fields based on bony landmarks. Intern J Radiat Oncol Biol Phys. 2006;64:205-209.
6. Bonin SR, Lanciano RM, Corn BW, Hogan WM, Hartz WH, et al. Bony landmarks are not an adequate substitute for lymphangiography in defining pelvic lymph node location for the treatment of cervical cancer with radiotherapy. Intern J Radiat Oncol Biol Phys. 1996;34:167-172.
7. Kim RY, McGinnis LS, Spencer SA, Meredith RF, Jennelle RL, et al. Conventional four-field pelvic radiotherapy technique without computed tomography-treatment planning in cancer of the cervix: potential geographic miss and its impact on pelvic control. Intern J Radiat Oncol Biol Phys. 1995;31:109-112.
8. Uno T, Isobe K, Ueno N, Kobayashi H, Sanayama Y, et al. Vessel-contouring-based pelvic radiotherapy in patients with uterine cervical cancer. Jpn J Clin Oncol. 2009;39:376-380.
9. Chao KC, Lin M. Lymphangiogram-assisted lymph node target delineation for patients with gynecologic malignancies. Intern J Radiat Oncol Biol Phys. 2002;54:1147-1152.
10. Taylor A, Rockall AG, Reznek RH, Powell ME. Mapping pelvic lymph nodes: guidelines for delineation in intensity-modulated radiotherapy. Intern J Radiat Oncol Biol Phys. 2005;63:1604-1612.
11. Eifel PJ, Winter K, Morris M, Levenback C, Grigsby PW, et al. Pelvic irradiation with concurrent chemotherapy versus pelvic and para-aortic irradiation for high-risk cervical cancer: an update of radiation therapy oncology group trial (RTOG) 90-01. J Clin Oncol. 2004;22:872-880.
12. Pendlebury SC, Cahill S, Crandon AJ, Bull CA. Role of bipedal lymphangiogram in radiation treatment planning for cervix cancer. Intern J Radiat Oncol Biol Phys. 1993;27:959-962.
13. Zunino S, Rosato O, Lucino S, Jauregui E, Rossi L, et al. Anatomic study of the pelvis in carcinoma of the uterine cervix as related to the box technique. Intern J Radiat Oncol Biol Phys. 1999;44:53-59.
14. Zhang X, Yu H. Evaluation of pelvic lymph node coverage of conventional radiotherapy fields based on bony landmarks in Chinese cervical cancer patients using CT simulation. J Zhejiang Univ SCI B. 2009;10:683-688.