A Ready Reference for Estimating Dose to Pelvic Node Metastases from High Dose Rate Brachytherapy (HDR-BT) in Cervical Cancer

Matthew R. McKeever, B.S.[1], Lindsay Hwang, B.S.[2], Jennifer Barclay, B.S.[1], Jeffrey Dubas, CMD[1], Yin Xi, M.S.[1], April Bailey, M.D.[1,] Kevin Albuquerque, M.D.[1].

[1]*University of Texas Southwestern Medical School, Dallas, TX, USA,* [2]*Case Western Reserve University School of Medicine, Cleveland, OH, USA.*

INTRODUCTION

Pelvic nodal metastases in cervix cancer indicate a poor prognosis but can be controlled by adequate radiation dose. A dose greater than 55 Gy is recommended for nodes 2 cm in diameter or smaller for durable control.

However, the dose received by the lymph nodes from cervix brachytherapy is often unknown and difficult to estimate. In this study, we explored the relationship between lymph node location, the dose received from brachytherapy, and the Point A dose as a means of assisting the radiation oncologist to determine the required additional external beam boost dose to pelvic lymph nodes

MATERIALS AND METHODS

This retrospective study from 2009 through 2013 included 29 cervical cancer patients receiving HDR-BT to a total of 60 metastatic pelvic lymph nodes.

The summated median Point A dose was 75 Gy, with 28 Gy from brachytherapy. The lymph nodes were mapped to different regions near the common, internal and external iliac arteries and measured on CT Scans under the supervision of a radiologist.

The treatment plan for each patient was then uploaded into Pinnacle (v. 9.4) and Eclipse (v. 10) treatment planning systems.

The lymph nodes were contoured and the Pinnacle dose volume histogram was used to find the dose from external beam, and the Eclipse dose volume histogram was used to find the mean dose from brachytherapy.

For brachytherapy there were 29 planning scans and 128 HDR treatment scans. The percentage of the point A dose received by each lymph node from brachytherapy was calculated.

ABSTRACT

Metastasis to lymph nodes is one of the best predictive indicators of recurrence and death for cervical cancer patients. A dose of greater than 55 Gy is recommended for nodes 2 cm or less for durable control. It is expected that nodes closer to the radiation source will receive a higher dose. In this study we explored the relationship between lymph node location and the Point A dose as a means of assisting the radiation oncologist to determine the required boost dose.

This retrospective study from 2009 through 2013 included 29 cervical cancer patients receiving high dose rate brachytherapy and had a total of 60 metastases to pelvic lymph nodes. The lymph nodes were mapped and contoured in the treatment planning system.. The external beam and brachytherapy doses and percentage of brachytherapy point A dose received by each lymph node were calculated.

The median doses from brachytherapy and external beam radiation to the lymph nodes were 5.5 Gy (range, 1.4-12.4 Gy) and 49.6 Gy (range, 42.5-62.9 Gy), respectively. The median total dose for all lymph nodes was 56.5 Gy (range, 46.5-66.3 Gy). The dose from brachytherapy accounted for 9.97% of the total dose to the lymph node. The location of the lymph node affected the dose received. The common iliac nodes, which were furthest from the uterus, received 3.18 Gy (11.09 % of point A); the internal iliac nodes received 4.29 Gy (16.43% of point A); and the external iliac nodes, which were closest to the uterus, received 6.05 Gy (21.75% of point A). As expected, nodes closer to the uterus received higher doses of brachytherapy radiation.

The results of this study provide radiation oncologists a reference for determining which pelvic nodal groups require an additional external beam boost dose and the optimal boost dose for those nodes, which could improve local control and outcomes for patients.

TABLE 1

Characteristics	Number of Lymph Nodes	Mean Total Dose in Gray (STD)	Mean Brachytherapy Dose to Lymph Node in Gray (STD)	Mean Dose as a Percentage of Point A Dose (STD)
Common Iliac Nodes Below Pelvic Brim	3	48.4 (2.0)	3.2 (1.6)	11.1 (5.8)
Internal Iliac Nodes	9	55.9 (6.9)	4.3 (2.4)	16.4 (9.4)
At/Above Sacroiliac Joint	5	54.1 (6.0)	3.4 (2.0)	13.3 (9.1)
Below Sacroiliac Joint	4	58.1 (8.2)	5.5 (2.7)	20.3 (9.6)
External Iliac Nodes	48	57.2 (5.0)	6.1 (2.7)	21.8 (8.9)
Anterior to Anterior Acetabular Line	7	57.6 (5.6)	4.9 (2.9)	18.2 (10.1)
Lateral to vessels	1	62.8	5.1	16.9
Medial to vessels	3	53.6 (3.9)	5.6 (4.5)	20.9 (15.1)
Posterior to Vessels	3	59.9 (5.8)	4.2 (2.0)	16.0 (7.8)
Posterior to Anterior Acetabular Line	41	57.1 (4.9)	6.2 (2.56)	22.4 (8.7)
Lateral to Vessels	2	50.7 (4.1)	2.5 (1.0)	9.8 (4.8)
Posterior to Vessels	39	57.4 (4.8)	6.4 (2.5)	22.3 (8.3)

RESULTS

The median doses from brachytherapy and external beam radiation to the lymph nodes were 5.5 Gy (range 1.4-12.4 Gy) and 49.6 Gy (range 42.5-62.9 Gy), respectively. The median total dose for all lymph nodes was 56.5 Gy (range 46.5-66.3 Gy).

The dose from brachytherapy accounted for 9.97% of the total dose to the lymph node. The location of the lymph node affected the dose received. The common iliac nodes, which were furthest from the uterus, received 3.18 Gy (11.09 % of point A); the internal iliac nodes received 4.29 Gy (16.43% of point A); and the external iliac nodes, which were closest to the uterus, received 6.05 Gy (21.75% of point A).

The number of nodes, mean total dose, mean brachytherapy dose and brachytherapy dose as a percentage of point A for each group and subgroup of nodes is shown in table 1.

CONCLUSION

The common iliac nodes received the smallest fraction of the brachytherapy dose and thus need the greatest external boost dose. Also the internal iliac lymph nodes above the sacroiliac joint, the external iliac lymph nodes anterior to the acetabular line, and the external iliac nodes lateral to the external iliac artery received a smaller amount of the brachytherapy dose than the rest of the nodes in their group.

This will require them to have a higher boost dose from external beam compared to other nodes in their group. The results of this study provide radiation oncologists a reference for determining which nodes require an external beam boost dose and the optimal boost dose for those nodes. Improved optimization of the boost dose should lead to better local control and outcomes for patients.