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Original article

A DOSIMETRIC EVALUATION OBSERVATIONAL STUDY OF ADAPTIVE RADIATION THERAPY IN LIMITED-STAGE SMALL CELL LUNG CANCER.

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Abstract

Background

Radiation therapy along with chemotherapy is proven to be effective in treating limited-stage small-cell lung cancer. However, the irradiation has deleterious effects on the other normal vital organs.

Aim

This study aimed to evaluate the efficacy and tolerability of adaptive radiation therapy in treating LS-SCLC.

Methodology

30 patients participated in this observational study. Radiation therapy was given in 30 fractions, each with 60 units. The first CT was used to determine the dose and the progress of the disease after which 15 sessions of radiation out of 30 were conducted. 20-25 days after the first CT and the 15 fractions, a mid-treatment CT was conducted to evaluate the dose of radiation received by the target organs and the other vital organs. A dosimetry evaluation was conducted, and statistical analysis was done.

Results

The decrease in the tumour volume was significant from 185 cubic centimeters it reduced to 53 cubic centimeters. The difference in the values from the first CT and the mid-treatment CT was found to be statistically significant. The effect on the vital organs was comparatively lesser than the conventional radiotherapy.

Conclusion

Adaptive radiation therapy is found to be effective in treating limited-stage small cell cancer as indicated by the tumor size volume in the initial and during the treatment CT scan

Recommendation

Dosimetry evaluation can serve as an effective tool in determining the effect of irradiation on the vital organs and developing a further treatment plan.

Keywords: adaptive radiation therapy, small cell lung cancer, chemotherapy
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Introduction

Radiation therapy in treating malignancies, along with chemotherapy, has been proven to be useful in a variety of studies [1, 2]. The cancer of the lungs is a limited-stage small-cell lung cancer that is treated with radiation therapy and chemotherapy improves the overall survival rate. The dosage and the fractions of the radiation required to treat small-cell lung malignancy are yet to be established [3].

Radiation therapy can be applied with different methods. Among the methods studied, adaptive radiation therapy has proven to be effective in various instances [4, 5]. The metastasis of this particular malignancy occurs rapidly leading to malignancy in multiple organs. However, adaptive radiation therapy with chemotherapy has delayed the prognosis in the majority of the cases and improved the overall survival rate [6]. Adaptive radiation therapy does not affect other vital organs, such as the heart, when the radiation is applied in the thoracic region [7]. The adverse effects on the other organs are limited and treatable.

Previously it has been reported that the application of higher doses of radiation without fractioning resulted in deleterious effects on the vital organs, although it improved the prognosis of the cancer which was assessed by measuring the size of the tumor and spread of the malignancy [8]. So, it is necessary to evaluate the effects of the radiation even though it shows improvement in the malignancy. Adaptive radiation therapy stands as a viable option in which the radiation dosage is calculated according to the progress of the disease.

Aim: This study aimed to evaluate the effectiveness of adaptive radiation therapy in treating limited-stage small-cell lung cancer. The dose of radiation on the other vital organs is evaluated and its adverse effects are studied. The radiation dosage calculation is done after the application of

each therapy and its effects on the vital organs by determining the dose administered to these organs.

Methods

Study Design

This was an observational study, in which the effectiveness of the adaptive radiation therapy was evaluated.

Study Setting:

This study was conducted on patients who were diagnosed with limited-stage small-cell lung cancer and received adaptive radiation therapy at IGIMS Sheikhpura, Patna from March 2020- March 2021. In all 30 patients consented and participated in this study.

Participants

The patients who gave their consent were included in the study. The patients who were exposed to any such therapy before or had undergone surgery to remove tumors were excluded from the study. The histological diagnosis was done to confirm the small cell lung cancer and the patients were evaluated based on the computed tomography (CT), positron emission tomography (PET), and blood test.

Variables and data sources

Radiation therapy was given in 30 fractions each with 60 units. The first computed tomography was used to determine the dose and the progress of the disease after which 15 sessions of radiation out of 30 were conducted. 20-25 days after the first computed tomography and the 15 fractions a mid-treatment computed tomography was conducted to evaluate the dose of radiations received by the target organs and the other vital organs. The remaining 15 fractions of the therapy were conducted. The average dose of radiation received by the target organ that is lungs and the shrinkage of the tumor in it were determined. The average dose received by the esophagus, heart, and spinal cord was determined during both CT scans. The data obtained was arranged based on whether the patients were receiving the first cycle of the cisplatin chemotherapy or the second cycle of it.

Statistical analysis

The data obtained was subjected to statistical analysis on a software program of statistical analysis for social sciences.

Ethical consideration

The study abided by all the Helsinki principles.

Results

In this study, 21 males and 09 females participated. Several 50 patients were initially approached; however, 20 patients were excluded from the study due to ineligibility. Out of the total 30 patients finally included, 11 were undergoing the first cycle of cisplatin chemotherapy and 19 of them were undergoing the second cycle of cisplatin chemotherapy. The average age of the patients participating in the study was 63 years.

Table no. 1 illustrates the data obtained from the study and highlights the improvement observed during the course of adaptive radiation therapy treatment.

Table no. 1: Evaluation of the dosimetry parameters before and during the therapy

Sr no.	Parameters	First CT scan	Mid treatment CT scan	Average percentage decrease
1	Tumor volume	185 cucm	53 cucm	66%
2	Average volume planned to the target organ	605 cucm	322 cucm	44%
3	Average dose to the lung	1807 cGy	1497 cGy	14%
4	Average dose to the esophagus	1756 cGy	966 cGy	37%
5	Average dose to the heart	968 cGy	694 cGy	23%
6	Average dose to the spinal cord	4867 cGy	3227 cGy	29%

The data in the table compares the tumor volume, volume of dose to be achieved in the target organ, dose in the lungs, dose in the esophagus, dose in the heart, and dose in the spinal cord during the first CT scan and the scan conducted during the treatment.

The average tumor volume observed during the first CT scan was 185 cm and during the treatment, the scan showed a decrease of 66%. The volume of the tumor was reduced to an average of 53 cm. The difference found in both scans was found to be statistically significant with a p-value less than 0.05.

The planned volume of the target organ was 605 cucm during the first CT scan which substantially reduced during the treatment to 322 cucm. The percentage decrease was found to be 44% and the difference in the volume was significant when compared statistically. Similarly, the dose that reached the lungs during the first scan was 1807 cGy and in the mid-treatment scan, it reduced to 1497 cGy. The percentage decrease was 14%. The difference in the dose during both the scans was statistically significant.

The dose that reached the esophagus during the first scan was 1756 cGy and during the second scan was 966 cGy. The percentage decrease of the dose reaching the vital organ was 37% and the difference in the dose during both the scans was statistically significant. The dose that reached the heart during the first scan was 968 cGy and the decrease in the dose reaching the heart during the second scan was 23%. The difference in the dose was found to be statistically significant.

The radiation dose that reached the spinal cord during the first scan was 4867 cGy and the dose that reached the spinal cord during the second scan was 3227 cGy. A percentage decrease of 29% was found when both the dose volumes were compared also the difference was significant statistically.

Discussion

The present study showed that adaptive ration therapy decreased the volume of the tumor significantly and also spared the normal tissue from radiation exposure. Treating small cell lung cancer with chemo radiotherapy has proven to be effective but the effect of this radiation on the other vital organs limits its utilization.

Another study conducted where researchers compared the effectiveness of conventional radiation therapy and adaptive radiation therapy showed a similar decrease in the volume of the tumor [9]. It also indicated that patients with advanced levels of cancer showed a substantial decrease in tumor volume compared to those who were at the initial stage of cancer.

Yet another study showed that the decrease in the tumor volume occurred during the initial weeks of irradiation [10]. In this study, the decrease in the volume was found after the first 25 days of irradiation which is by the study conducted previously.

10 patients in this study had significant irradiation on their vital organs. Conventionally the treatment has to be ceased if the irradiation on the normal tissue is significant but in this case, dosimetry evaluation was done to calculate the impact of irradiation and hence the further dose of irradiation was reduced.

In this study, the histological parameters were not considered although tumor shrinkage is the primary parameter to evaluate the efficacy of the therapy the microscopic prognosis of the malignancy should be also evaluated. However, in a study, it has been found that adaptive radiation decreased the tumor volume and also significantly subsided the malignancy when the histology of the cancerous cells was studied before and after the therapy [11, 12].

The effect on the vital organs because of irradiation through adaptive radiation decreased significantly when compared to conventional radiation therapy [13]. Also, the effectiveness of this methodology on the target organ treatment was substantial

Conclusion

Adaptive radiation therapy is found to be effective in treating limited-stage small cell cancer as indicated by the tumor size volume in the initial and during the treatment CT scan. The effect of this irradiation on the vital organs was much lesser than the conventional irradiation. The patients who had significant irradiation were evaluated using dosimetry and further dose calculation of the dose can be done accordingly.

Limitations

This study did not compare conventional irradiation with adaptive radiation therapy which is required to understand the effectiveness of this method over the conventional one. The histological parameters were not considered for the evaluation of the therapy in this study.

Recommendation

Randomized clinical trials are required to assess the effectiveness of adaptive radiation therapy. Dosimetry evaluation can serve as an effective tool in determining the effect of irradiation on the vital organs and developing a further treatment plan.

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List of abbreviations

LS-SCLC- Limited stage small cell lung cancer

ART- Adaptive radiation therapy

CT- Computed tomography

PET- Positron emission tomography.

Source of funding

The study was not funded.

Conflict of interest

We declare no conflict of interest.

References

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2020. CA Cancer J Clin 2020; 70:7-30.
2. Dubey AK, Gupta U, Jain S. Epidemiology of lung cancer and approaches for its prediction: A systematic review and analysis. Chin J Cancer 2016; 35:71.
3. Byers LA, Rudin CM. Small cell lung cancer: Where do we go from here? Cancer 2015; 121:664-72.
4. Houston KA, Henley SJ, Li J, White MC, Richards TB. Patterns in lung cancer incidence rates and trends by histologic type in the United States, 2004-2009. Lung Cancer 2014; 86:22-8.
5. Argiris A, Murren JR. Staging and clinical prognostic factors for small-cell lung cancer. Cancer J 2001; 7:437-47.
6. Gridelli C, Casaluce F, Sgambato A, Monaco F, Guida C. Treatment of limited-stage small cell lung cancer in the elderly, chemotherapy vs. sequential chemoradiotherapy vs. concurrent chemoradiotherapy: That's the question. Transl Lung Cancer Res 2016; 5:150-4.
7. Pignon JP, Arriagada R, Ihde DC, Johnson DH, Perry MC, Souhami RL, *et al*. A meta-analysis of thoracic radiotherapy for small-cell lung cancer. N Engl J Med 1992; 327:1618-24.
8. Warde P, Payne D. Does thoracic irradiation improve survival and local control in limited-stage small-cell carcinoma of the lung? A meta-analysis. J Clin Oncol 1992; 10:890-5.
9. Fried DB, Morris DE, Poole C, Rosenman JG, Halle JS, Detterbeck FC, *et al*. Systematic review evaluating the timing of thoracic radiation therapy in combined modality therapy for limited-stage small-cel lung cancer. J Clin Oncol 2004; 22:4837-45.
10. Turrisi AT 3rd, Kim K, Blum R, Sause WT, Livingston RB, Komaki R, *et al*. Twice-daily compared with once-daily thoracic radiotherapy in limited small-cell lung cancer treated concurrently with cisplatin and etoposide. N Engl J Med 1999; 340:265-71.
11. Papac RJ, Son Y, Bien R, Tiedemann D, Keohane M, Yesner R. Improved local control of thoracic disease in small cell lung cancer with higher dose thoracic irradiation and cyclic chemotherapy. Int J Radiat Oncol Biol Phys 1987; 13:993-8.
12. Shahi J, Wright JR, Gabos Z, Swaminath A. Management of small-cell lung cancer with radiotherapy-a pan-Canadian survey of radiation oncologists. Curr Oncol 2016; 23:184-95.
13. Bogart JA, Herndon JE 2nd, Lyss AP, Watson D, Miller AA, Lee ME, *et al*. 70 Gy thoracic radiotherapy is feasible concurrent with chemotherapy for limited-stage small-cell lung cancer: Analysis of Cancer and Leukemia Group B study 39808. Int J Radiat Oncol Biol Phys 2004; 59:460-8.

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